CHEMICAL & METALLURGICAL ENGINEERING

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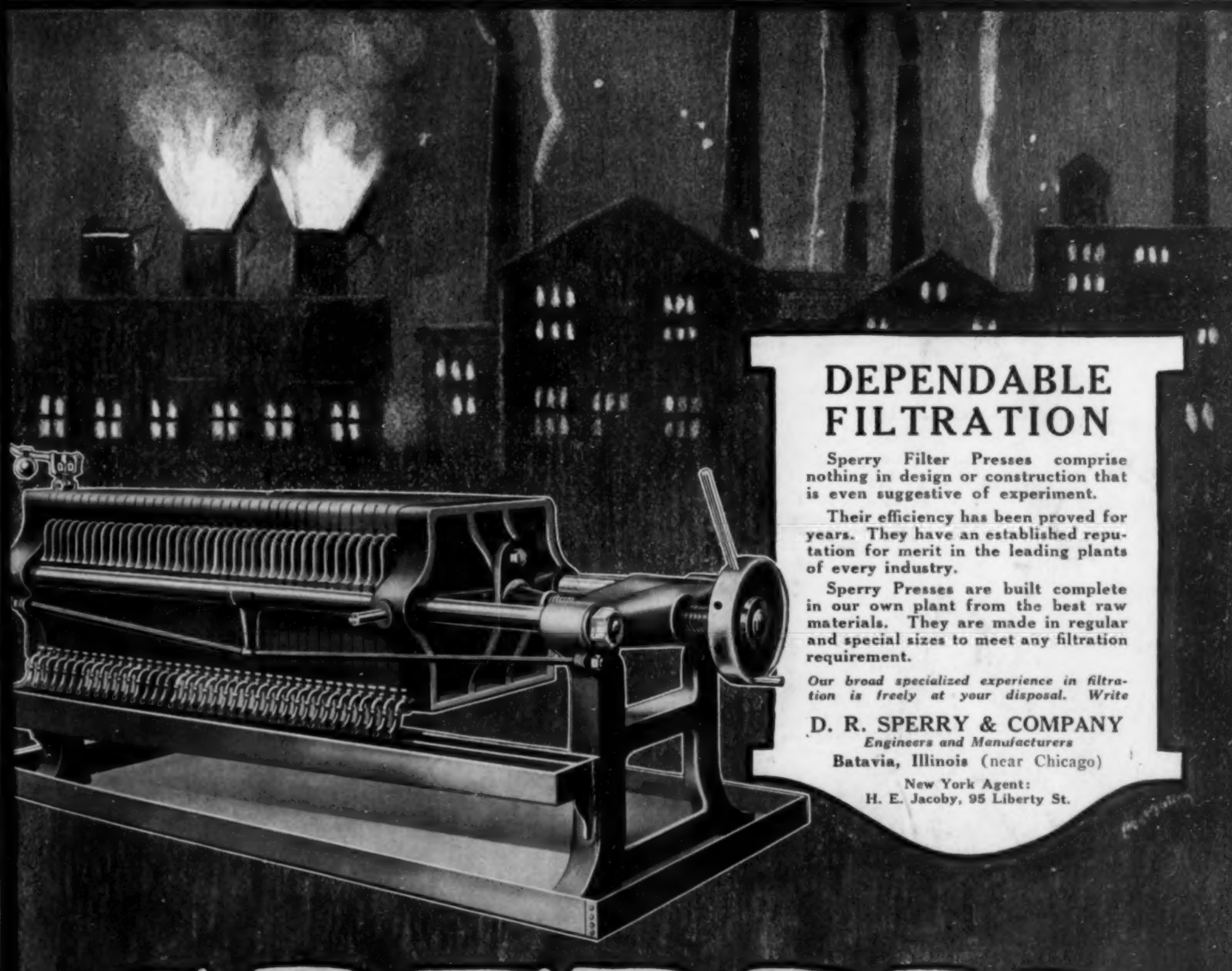

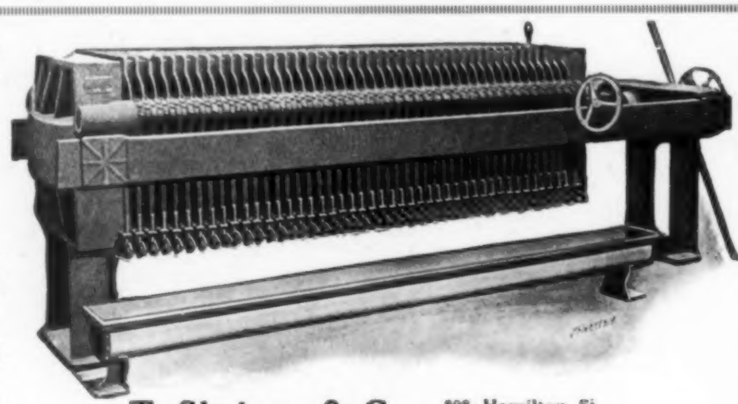

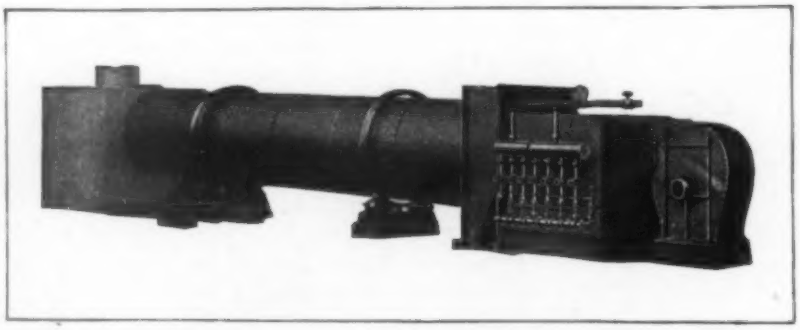

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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

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Volume 19, Number 1

Ourselves

FOUR times within the history of this journal we have injected a personal note into the editorial columns. The first occasion was when we introduced ourselves, nearly sixteen years ago. Twice after that we explained the successive changes in name which the journal underwent, and finally in 1912 we celebrated the tenth anniversary "of an insurgent engineering journal." Looking back over the record as it has been written in eighteen volumes, we may be pardoned if we indulge just a moment's gratification over the unfailing approval which our readers have so freely and genuinely extended as we have developed in the passing years. Truly, our readers have made possible by their splendid support whatever of achievement may be recorded in our volumes.

From the beginning this journal had a field that was not covered by any other similar publication. Unhampered by precedent and encouraged by a wonderfully friendly reception, we found it comparatively easy and delightful to break new trails. Always we have kept in mind the needs of the industry which we served, and whenever expansion or change seemed appropriate in the interest of better service we have never hesitated to make the effort to meet the need. Successful technical journalism requires a recognition of industrial trend and adaptability to changing conditions. Given these elements internally and the support of the profession from the outside and the result is inevitable. It must now be quite evident to any observer of current industrial development what we foresaw several years ago, namely, that chemical engineering is playing the dominant rôle of the day. Our country stands on the threshold of a marvelous development which has its basis in applied chemistry. There is scarcely an industry of any magnitude or importance that is without its chemical phase, and we are but beginning to appreciate the value of chemical control. Due to the stimulus of war we have suddenly become a chemical nation, investing millions in chemical manufacturing both on government and private account, and staking the future industrial independence of the country on the chemist and engineer.

It is under these favorable auspices, which we anticipated when we began semi-monthly publication several years ago, that CHEMICAL AND METALLURGICAL ENGINEERING now greets old friends with a revised and more appropriate name. There is fitness and proportion in all things—even names—notwithstanding the implication to the contrary in the classic query of the poet. Today's name would not have fitted the pioneer days of electrochemistry when this journal was launched, nor would *Electrochemical Industry* fitly indicate the broad field of

chemistry applied to industry and ore treatment which characterizes our field today. Further, as the metallurgist's art has progressed from rule-of-thumb to scientific standards, chemistry has been the underlying factor in the change. Metallurgy, therefore, has become a great branch of chemistry applied to the treatment of ores and metals—one great phase of our chemical industry. And so, with confidence in the logical nature of the change we have made, and feeling assured of the approval of our friends in this step in the evolution of a live, independent exponent of the chemical and metallurgical industries, we enter upon a new volume with a new sense of responsibility. Our house is now in order. We espouse the cause of the chemical engineer, the metallurgical engineer, and of those close relatives, not hyphenated, who are differentiated by the prefix "electro." We abandon no phase of the industry that has been included in our past evolution. There will be no diminution in our attention to electrochemistry and electrometallurgy. The treatment of ferrous, non-ferrous, precious and base metals and ores will have our interest as in the past, and the rapidly expanding chemical industry will be fitly served as becomes so important a factor in our national life.

Speaking of Lead, Who Pays the Freight?

FIFTY years ago lead was cheap because it came from easily worked bonanza deposits. Since then the upward tendency due to the steady decline in grade of ore and increase in cost of labor has been counterbalanced by improvements in mining and metallurgical methods, together with decrease in freight rates. Indeed, the last item, freight, is so important to Middle Western and Western producers that it would be profitable to consider the effect of Mr. McAdoo's recent revision of rates. The increase amounts to 25 per cent on most commodities, ranging upward on essentials like coal, coke, flux and ore to a probable maximum of 55 per cent on bullion. With such unexpected jumps in the price of transportation, the custom smelter who contracted several years ago to treat ore at a price based on current and expected costs at that date is left with the alternatives of negotiating for a revision of the payment schedule, shutting down, or tumbling into bankruptcy.

The purely custom smelter or refinery operates under entirely different conditions from one which treats its own ores. The latter's deficit on a rising market may easily be swallowed by the handsome profit of the producing and selling departments. The custom smelter, on the other hand, is something like a salaried man if it operates on a "cost plus" schedule; in effect it then works for the miner, being but one of a train of related industries necessary to take lead from underground and put it into the plumber's pot. The total cost of the train must not only be less than the selling price of the metal, but the miner must get a share sufficient to pay for the delivery of the ore to the smelter, who in turn must receive a portion necessary to load the pig on cars. Lastly, the refiner's income at the least must balance his cost of putting usable metal on the market.

The production of lead is a field particularly well suited to study the effects of inflated prices. For years the price has fluctuated within such narrow limits that mutual relations between the various parties to the production were well stabilized, and it had become almost a common saw that "Four cents is a good price for lead." On this basis the average of 4.3 cents for the decade ending with the war evidently provided a comfortable, perhaps more than comfortable, share for miner, smelter and refiner, with somewhat the following partition:

	Cents
Mining	1.4
Smelting	1.8
Refining	1.1
Total	4.3

It will be noted in passing that these approximately correct figures correspond to conditions in those regions feeding the Colorado and Utah smelting centers. Most of these ores, of course, carry other valuable metals than lead, but the entire cost of smelting is assessed against the average lead content. This gives a fictitiously low return to the miner for his lead, but his receipts are augmented by the values of gold, silver, copper and iron. The case has thus been simplified for the argument which follows, since the wartime appreciation in market value of silver and copper has been equal to or greater than that of lead. "Mining" is thought of as including mining, development, amortization, freight and all other expenses incidental to delivering the ore to the smelter. "Smelting" includes the entire cost of recovering the base bullion, while the item "refining" covers freight on bullion and selling costs as well.

Since the war the price of everything has soared. In an inquiry in the Salt Lake region it was found that labor is receiving 50 per cent more now, for a considerably less efficient performance. Supplies have increased 35 per cent, coal 30 per cent and coke 50 per cent. On this basis the statement freely repeated that production costs have increased two-thirds in the last four years appears somewhat exaggerated when applied to the lead-smelting region; possibly an average increase of 50 per cent would represent the costs ruling for the first half of 1918. Therefore, in order that the operations may now proceed as comfortably as before, the new apportionment would approximate

	Cents
Mining	2.1
Smelting	2.7
Refining	1.6
Total	6.4

The market was about 6.8 cents during this time, the surplus 0.4 cents going generally to the miner, who thus seems to be better taken care of than his partners. Indeed, it is unquestionable that the two latter have not increased their income proportionately to their costs, since so many old contracts are still in effect. In other words, the adjustment of contracts will lag far behind, while the ore shipments closely hug the rising markets.

But assuming for the instant that each has revenue enough to enable him to carry on his share of the work, now comes an increase in freight rates, bad enough in itself, but scaling all prices upward to an even greater extent. Carriage on bullion alone is increased 0.3 cents per pound. The smelter is hard hit on account of its

large requirements of flux, coal and coke. The miner weeps over his ore freights. An estimated reapportionment of expense would now be

		Cents
Miner	2.1 + 0.2 =	2.3
Smelter	2.7 + 0.3 =	3.0
Refiner	1.6 + 0.4 =	2.0
Total		7.3

It is only another instance of the unending cycle: Up go wages, up go butter and eggs. Up go butter and eggs, up go wages. This much is plain, however: producing lead on a 7-cent market in 1918 is not as good a business proposition as on a 4-cent market in 1914. And when the price of lead exceeds the cost of production, as it will sooner or later by the operation of natural laws or by governmental price-fixing, the three partners in the business of producing lead must mutually revise their agreements so that each can continue to perform his indispensable functions. The mining company, for instance, can easily see the folly of insisting upon the continuance of a contract which will shut down the smelter, for he evidently could find no other present outlet for his ore on the old basis. On the other hand, a smelter with a sliding-scale contract which pinches the small producer should not strangle this output, even if small. Fair-minded men realize that the violent fluctuation of supposedly stabilized transportation is one of the things beyond control which invalidate price agreements; patriots subscribe to the motto, "Produce more, consume less"; and common sense indicates that galena is no good for making shrapnel bullets.

On the Price of Gold and Other Things

THE gold producer is between the devil of leaner ore and the deep blue sea of fatter commodity and labor prices. The before mentioned devil has kept the world's gold output practically stationary for the last ten years, and strenuous efforts to lower extraction costs by improved mining and metallurgical management have been overwhelmed by a tidal-wave of war prices.

Suppose you had revised your boiler room practice and equipment with much care and had finally increased the overall efficiency by some fifteen per cent. After looking over the results with considerable complacency you receive a letter one morning from your coal contractor saying that thereafter the price of your fuel will be the \$2.50 allowed by administrative action instead of the \$1.00 called for by your contract. Then you would feel as the gold miner feels.

The copper producer is in a different boat. He had cannily taken advantage of the present style in price-fixing and can point out that the increased cost of living demands a higher wage. For be it understood that the law (if it be a law) of supply and demand is distinctly out of date; Mother Grundy has whispered that a ruffian called Mars has spiked its guns, so that the time-honored statute can be winked at with impunity.

Time was when the impression was abroad that the more a man produced the better he should be paid, that the more efficiently a business was conducted the better should be the profits. Maximum production with the minimum expenditure seemed the ideal which would provide amply for the comfort of great and small. But apparently we were all wrong—now-a-days wages are fixed by the cost of living, men and industries are paid according to what they spend, the tradesmen get all they can and let the hindmost look out for himself. Truly a comfortable creed if you are some distance from the hindmost, but a rule of conduct not calculated to cause soul-searching as to whether one is doing the best that is in him, or getting the best out of his tools.

Fortunately, there is a tacit agreement that this new philosophy is spurious and results in a vicious cycle of increasing prices, for all of us, through our government, have agreed to tax the war excess profits, proceeding on the theory that no one should grow fat on blood money. Right here is where the gold miner feels aggrieved. Theoretically, war taxes are imposts on excessive income returned from the inflated prices attending this cataclysm. Everyone can and does charge more for his produce than he could before, *except* the gold miner. The price of his yellow metal was established internationally long before the present price-fixing program was imagined; but unfortunately the more fundamental relationship between an ounce of gold and a day of labor was not recognized. Consequently the price of gold actually has dropped through its inability to purchase the old amount of other necessary products of man's labor. Since war prices have brought only a decrease in net revenue to the gold miner, his claim for exemption from war-profit taxation is well founded. It will probably fall on deaf ears, however, since to the ordinary run of mankind mining is a speculative enterprise rather than a foundation stone of industry.

The ultimate relationship of the value of gold and of all other things is somewhat as follows: If a country needs a thing, such as it does gold, and needs it badly, its citizens set themselves about getting it. If it exists, it can be had for a price. But the price paid to get it must not be greater than that which it in turn will buy. Therefore, as long as gold is to be the monetary standard, its value must fix the maximum limit to the price of labor and commodities. The spectacle of a stagnating gold production, while painful to the gold miner, is a welcome indication that, taken in a large way, the crest of high prices has been reached; a halt must be called else passing time will dangerously inflate an already top-heavy financial structure.

Devil-Hounds and Hounding the Devil

EVERY red-blooded unhyphenated American must have rejoiced recently at the published accounts of the performance of our marines when put to the supreme test in battle. Widely advertised in recruiting campaigns as "the first to fight," they ran true to form and showed that they were the last in the fight as well. Report has it that the enemy characterized them as *teufelhunde* after his first contact with them, but we rather incline to the artist's idea as expressed in the colored supplement to this issue, and agree with him that our marines are engaged in the laudable pursuit of hounding the devil. We suggest to our readers and subscribers that this supplement may be made to serve a useful and patriotic purpose if posted in the office or plant where the artist's inspiration may be transmitted to all.

Meeting of the American Institute of Chemical Engineers

Important War-Time Convention Well Attended by Members from Distant States—Exceptional Opportunities Afforded to Visit Pulp, Paper and Chemical Plants of the Brown Company

THE tenth semi-annual meeting of the American Institute of Chemical Engineers was held June 19-22 at Gorham, N. H., which is the nearest village to the summit of Mount Washington—16 miles by carriage and automobile road. Gorham is surrounded by high mountains, there being twelve peaks within an eight-mile radius, the average height of which is more than 5000 feet. Mount Adams, as seen from Gorham, is the highest rise of land of its kind east of the Mississippi river. Sweetsir's Guide Book says: "Mount Adams, as seen from a point on the road about one and one-half miles beyond the village, is the highest elevation which we can look at in New England from any point within a few miles of the base. Indeed, it is the highest point of land overlooking a station near the base that can be seen east of the Mississippi. The peak of Mount Adams (5805 ft. high) is about seven miles from the point before mentioned (868 ft. high), above which it towers to the height of 4937 feet; while Mount Washington rises but 4722 ft. above Fabyans and Bretton Woods, and 4661 feet above the Glen."

1. Wallace Savage
2. W. C. Graham
3. E. H. Leslie
4. Richard K. Meade
5. P. D. Bray
6. F. E. Dodge
7. H. O. Chute
8. Louis A. Olney
9. George Oenslager
10. Ralph H. McKee
11. W. H. Shearman
12. Henry G. Sommer
13. J. L. Schuelef
14. Hugh Kelsea Moore
15. S. Felton Grove
16. William F. Zimmerli
17. Stephen L. Tyler
18. T. B. Wagner
19. J. C. Olsen, Secretary
20. W. P. Mason
21. L. D. Vorce
22. A. C. Langmuir
23. W. B. Campbell
24. E. C. Holton

Welcomed to New Hampshire

On the arrival of the Institute Wednesday forenoon MAYOR GEO. F. RICH met the organization at the Berlin City Hall and turned over the keys of the City. MR. JOHN HULAN spoke eloquently in appreciation of the honor of entertaining such a distinguished organization and informed the members that the Chamber of Commerce had arranged with citizens to furnish sufficient automobiles to carry the Institute to and fro. MR. O. B. BROWN spoke at the Grotto after lunch, where he told of the transition of the saw mill, starting in 1846 with the enormous mill-waste fires, through a period of forty-five years, when the sulphite wood pulp process was finally developed about 1888. Many ingenious ways of

Power Plant Cell House Bleach House Chemical Plants

ELECTROLYTIC AND CHEMICAL PLANTS OF THE BROWN CO.

getting laths, shingles, etc., from normally unfit slabs were developed by saw-mill engineers, but nevertheless thousands of dollars worth of material was wasted weekly. In Michigan the mill people turned to chemistry and put up brine evaporators and Saginaw became the Salt City. The pulp process was the contribution of the chemist in the spruce belt, by which not only the waste was conserved, but thousand of square miles of small timber, practically valueless as it stood on the cut-over hills, was soon made a precious harvest crop. MR. BROWN did not speak at length, but his actions during the visit of the Institute expressed better than words the cordiality of his welcome.

LADIES WELL ENTERTAINED

The automobile service was the greatest treat in filling the program for ladies. The scenery of the White Mountains is an attraction that all ambitious travelers crave, and under the leadership of MRS. O. B. BROWN, MRS. HUGH K. MOORE and a dozen others the visiting ladies saw this famous section of New England better than the chauffeured tourist ever did.

THE BROWN MILLS, BERLIN, N. H.

The Institute chose Gorham, so famous as a resort of the White Mountains, not merely because it offered its members a pleasant vacation from industrial pursuits, where they could discuss papers and become better acquainted through personal contact, but because from precedence as much as anything else, and certainly not from a lack of appreciation for the aesthetic; it has been customary to hold these meetings at such points as offered visiting privileges to highly important chemical manufacturing plants. Fortunately, MR. HUGH K. MOORE, through his connections with The Brown Company, secured permission for his fellow members to visit their enormous lumber, pulp, paper, oil and chemical factories, which form the economic foundation of the thriving city of Berlin, but a few minutes ride by auto or trolley from Gorham.

25. John Morris Weiss
26. Chas. S. Hollander
27. Ray Potter Perry
28. Paul I. Merrill
29. W. C. Bainbridge
30. Luis E. Eckelmann
31. A. L. Gardner
32. Colby Dill
33. Robert D. Bonney
34. Percy C. Kingsbury
35. Philip S. Barnes
36. Jules Bebie
37. H. Gesell
38. W. O. Quayle
39. A. E. Nash
40. J. H. Clewell
41. David Wesson
42. Fred A. Whitaker
43. James P. V. Fagan
44. Geo. A. Prochazka
45. T. P. Summers
46. William Garrigue
47. H. G. Spear
48. C. Bai Lihme

Sulphite Pulp Mills

By the time one approaches these large mills, the sense of proportioning mass has been greatly augmented by the mountain scenery so that the 100,000-cord mountain-like wood pile at the supply yard does not excite even as much surprise as the ancient wooden horse of Troy. Nevertheless, the enormous wood-barking drums, the gang saws, the chippers and sorters, the extensive and various conveying appliances which deliver the wooden chips into any one of the long rows of digesters, the appliances for chemically controlling operations, and finally the sulphur burners and the acid absorbing towers, bring emphasis to the statement that besides being the largest sulphite pulp mill in the world, this is certainly one of the greatest consumers of the products of nature. The magnitude of the operations may be summarized in the fact that if the daily wood supply of these mills were piled four feet high and four feet wide, it would extend over two miles in length.

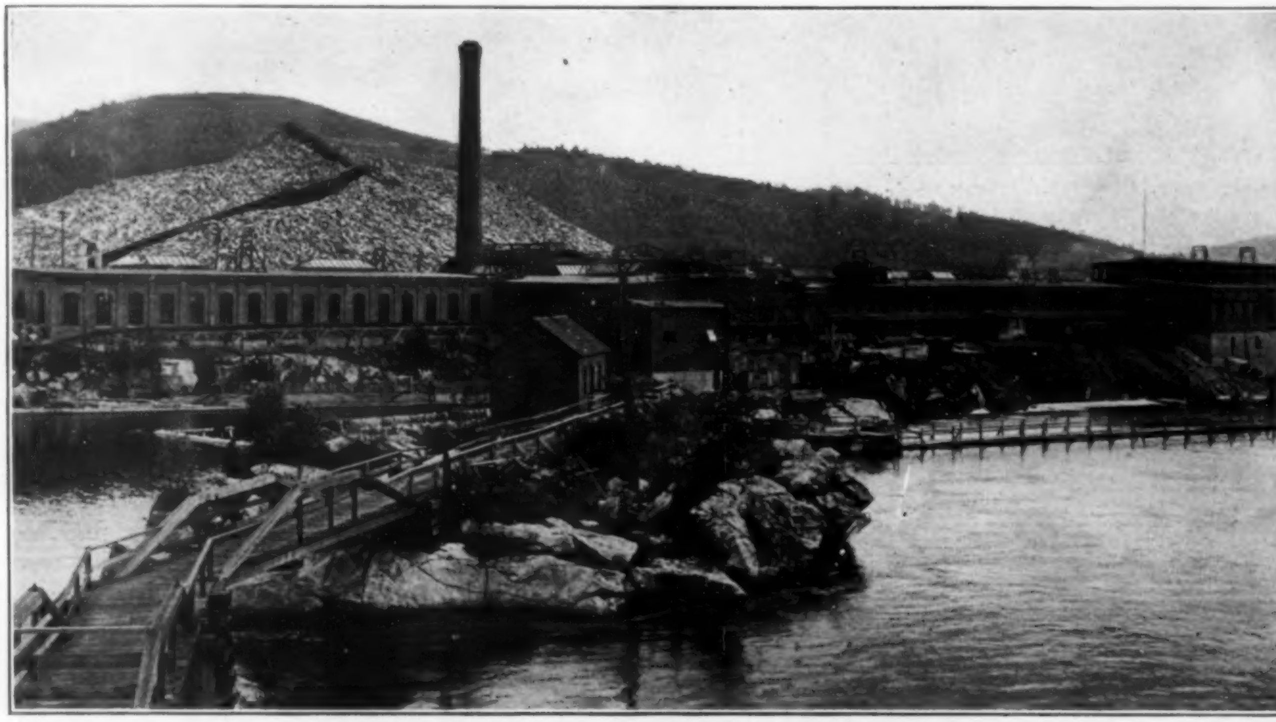
The Cascade Paper Mill

Not all of the pulp is sold as such by the company, the Cascade Mill shipping about 200 tons of paper daily. In the operation of this plant there are employed 800 persons receiving about $11,000 per week; 23,000 horsepower is generated, of which about 8000 is electric and 7000 each hydraulic and steam; seventeen 400-hp. boilers burn 125 tons of coal daily in furnishing steam. Four immense paper machines each produce 48 tons of news paper daily, which is 164 inches wide and runs through the machine at the rate of 600 ft. per minute.

The Chemical Department

Years ago the company bought its bleaching powder from England, but for some time has operated its own electrolytic cells of a design by Messrs. Moore and Allen. An extremely chlorate-free sodium hydroxide solution is produced, which is concentrated, desalted and dehydrated to 76 per cent Na_2O, which is then put in the usual form of drum for shipment. Bearing in mind that the policy of this company is to utilize all by-products, one is not at all surprised to find a little brick furnace, heated to incandescence, up on the cell-house roof, which is believed to be the first commercial furnace burning hydrogen in chlorine gas as well as the only known hydrochloric acid plant that works without any attendants.

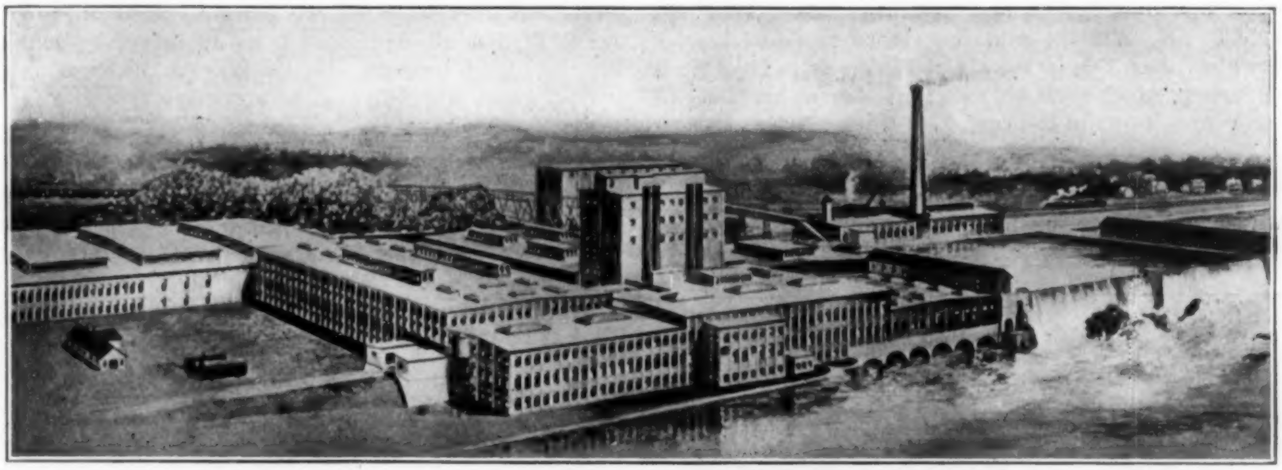
Having quantities of sulphur on hand for use in the sulphite mill, it was no more than natural that the sulphur chlorides should be made by burning sulphur with chlorine, also that wood charcoal and sulphur should be combined to carbon disulphide, and that from the above carbon tetrachloride and chloroform should follow in sequence. Medicinal chloroform is also made by the alcohol-bleaching powder method in tank-car quantities at the present time.



RIVERSIDE MILL AND WOOD YARD OF THE BROWN CO.

The Oil-Hydrogenation Department

Dr. Carleton Ellis has written a book on this subject so that the interested reader may find elaborate published accounts of how oils in the presence of nickel will absorb hydrogen gas and change their properties by becoming solids at ordinary temperatures. Pure peanut oil is used in the Brown plant. The features of the process are the thorough manner in which the reagents are brought into contact, the moderate temperatures and the reaction speed, so that the fat is soon on the chill rolls, then into the "Kream Krisp" container. The art of the oil refiner is to purify this carbon-hydrogen-oxygen compound—oil—furnished us by nature. With the exception of adding hydrogen to the product as in the above process, all oil refining consists of removing foreign products by washing out fatty acids, etc., with dilute alkali, removing soaps, colors, etc., with fuller's



CASCADE PAPER MILLS OF THE BROWN CO.

earth, and steam-distilling all odorous volatile oils and moisture from the finished product.

Photographic Department

Of the many technical laboratories special mention should be made of the photographic department. Mr. John H. Graff has developed many applications of color photography in technical analysis of pulp from various woods. Very beautiful artistic pictures of chocolate coatings, etc., were shown which approached the actual color and texture of the original specimens. There is promise that the physical qualities of oils and fats will eventually be studied by this method similar to those of steel and alloys in metallography. Mr. Graff has a blue center on a red field through which he filters the microscope light, so that the finest differentiation between the planes of cleavage, faces, etc., is obtained in the photograph. His photos of jewels, such as diamonds, are the best means known today for recording the true color effects as well as physical forms and thus give positive identification records.

The social welfare of the workers in the Brown Company has not been provided for on the seventh day alone. Fine club houses for young women and men have been erected; but more unusual and greater than all is the "Show," which stimulates good fellowship better than any other activity and provides mental training for scores of participants.

The members of the Institute agreed that they had never witnessed better amateur talent than by the Burgess Minstrels in the presentation of "A Joyous Jumble of Junk" in three acts entitled "Somewhere in America." Mr. Herbert Spear proved to be as much at home leading a company of ninety as though he were by profession a "Comical Engineer" instead of chemical. Dennis Campbell and Lora Rowell presented the rural act in refreshing manner. The "Six Smiling Scoundrels" were as capable as if they had seen service with Lew Dockstader himself. Of their acts, the kiddy kar worked extremely well and would take New York almost as well as the Daffodils did under the lead of Bessie McCoy. Of their riddles; the "Resemblance of a Slacker to a Lemon Pie" may be taken as an average. Some good ones were perpetrated on a few individual members of the Institute, but the "No Crust on Top and Yellow Inside" was left for each individual himself to

BURGESS SULPHITE PULP MILL OF THE BROWN CO.

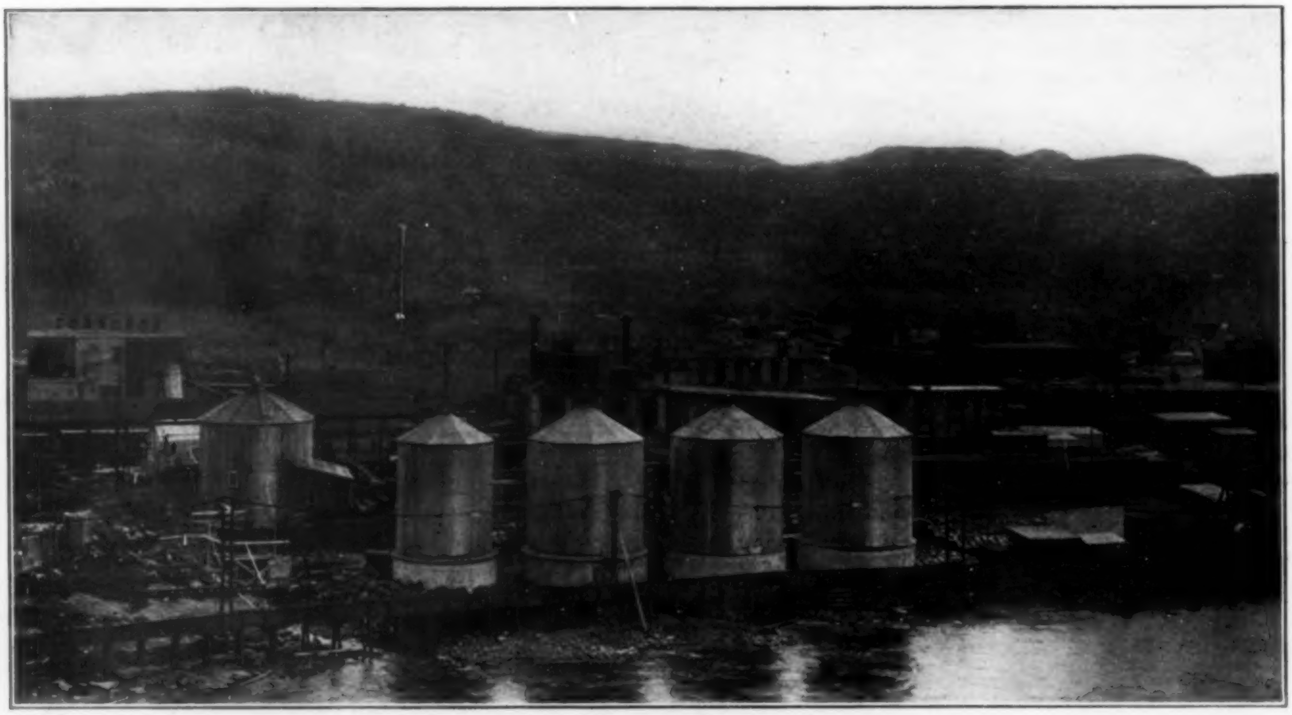
determine how far he had a right to stray from the kahki. DR. WESSON said that there was less than a third as much CO_2 in the air at Berlin as in New York or Boston, which must account for the extra brilliance of the young ladies in the cast.

BANQUET AT THE MT. MADISON HOUSE

One hundred and four covers were laid at the tables which were set in the form of a large U. DR. MASON acted as toastmaster. MR. W. R. BROWN, who has charge of the timber operations of the company, made an address, and while he did not mention the fact that his department is really the largest manufacturing department of the whole company, where cellulose is manufactured by catalytic action of sunlight on CO_2 in the leaf cells, where the water vapor from the Atlantic ocean is condensed on the mountain sides to keep the Androscogin flowing, and where storage reservoirs have been built to regulate the current, etc., yet he did promise to furnish all those who came up into the woods a regular Brown welcome. DR. OLSEN gave the toast to the ladies, which was delivered in a manner typical of the genial Secretary of the Institute.

TRIP THROUGH THE MAINE WOODS

A heavy rain began Friday night which continued all day Saturday, but after voting on whether it was advisable to mke the scheduled trip up through Thirteen-mile woods to Errol Dam, so many members decided to go that the official meeting was transferred to the Lakewood Camps in spite of the weather.



OIL REFINERY AND HYDROGENATION PLANT OF THE BROWN CO.

Fourteen papers were read during the meeting, occupying ten hours time. Some of these will be printed in full or in abstract form in future issues of CHEMICAL AND METALLURGICAL ENGINEERING. Every minute of the trip was time enjoyably spent.

Government Restricts Location of New Industries

A policy has been adopted and made effective for preventing further increase in the volume of war orders and the number of establishments handling them in the area known as the congested manufacturing and transportation district. This district comprises the New England states; eastern and southern New York; Pennsylvania as far west as Williamsport and Altoona; all of New Jersey and Delaware; eastern Maryland, not including Baltimore.

Exceptions to this policy will be made only if unavoidable through inability otherwise to provide for war needs.

The congested district comprises those eastern states in which so large a proportion of war industries is located as to make it difficult to supply all with necessary raw material and fuel. This difficulty obtains because coal for those industries is mined in the territory west of the Allegheny Mountains. It must be carried into this congested district by a limited number of railway lines and by ships from Hampton Roads and Baltimore.

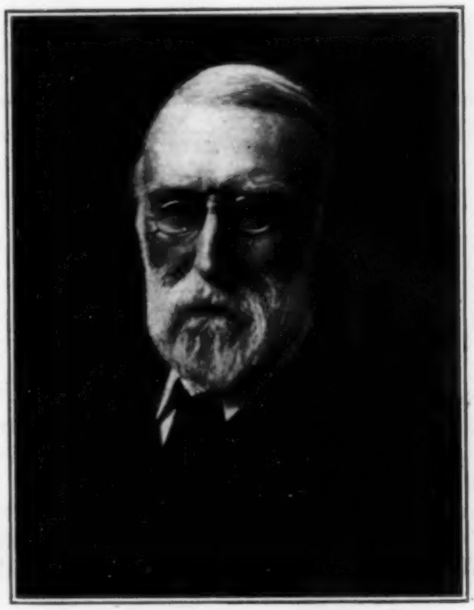
The amount of coal, therefore, which can be transported into this congested area during any one season is limited, and is an entirely separate problem from the production of coal. However much coal is mined in western Pennsylvania, West Virginia and Ohio, only so much is available for this congested district as the railroads and ships can transport.

A careful analysis of the possible coal movement shows that the increased industrial activity in those eastern states has created a requirement for coal which exceeds the limit of possible transportation of coal, plus necessary materials for manufacture. A map of the congested and restricted district has been issued to all Government departments.

James Douglas

DR. JAMES DOUGLAS, philanthropist, mining engineer, chairman of the board of directors of the Phelps, Dodge Corporation, died at his home in Spuyten Duyvil, near New York City, on June 25 in the eighty-first year of his age. He had been president of the corporation for many years until recently, when he resigned on account of failing health.

Dr. Douglas gave away large sums of money for educational and charitable purposes, but his most noteworthy gift was made to the General Memorial Hospital of New York of 3.75 grams of radium, value $375,000, to be used in cancer-therapy. This radium represented one-half of the output of the National Radium Institute produced by three years of work on carnotite ores in the West. Dr. Douglas was born at Quebec, Canada, Nov. 4, 1837. His father, Dr. James Douglas, Sr., was a surgeon of repute, and the first to introduce modern treatment of insanity into Lower Canada, as the founder of the Quebec Lunatic Asylum, in the management of which for some time his son James participated. James Douglas was educated in Canada, Germany and Scotland. He received the degree of A. B. at Queens University, Canada, studied medicine at Laval University and was professor of chemistry at Morrin College, Quebec. He acquired his first experience in mining and metallurgy through his connection with the Harvey Hill mines and other mining properties in Lower Canada and went to Phoenixville, Pa., in 1875, where he took charge of the metallurgical operations of the Chemical Copper Co., where he was first to refine on a commercial scale pure copper by the electrolytic method.



JAMES DOUGLAS

In 1880 Dr. Douglas first visited Arizona and saw the Copper Queen mine, and a year later, in the interest of the late William E. Dodge and the late D. Willis James, of the old firm of Phelps, Dodge & Co., acquired copper claims in the Warren mining district, Arizona, and the copper mines at Morenci, Ariz. These claims in 1885 had become productive, and were absorbed into the Copper Queen Consolidated Mining Company, of which Dr. Douglas became president.

Later, the Detroit Copper Mining Co., Morenci, Ariz.; the Untied Globe mines, Globe, Ariz.; the Moctezuma Copper Company, Nacozari, Sonora, Mexico; the Commercial Mining Co., Prescott, Ariz.; the Stag Cañon Fuel Company, Dawson, N. M.; and the Burro Mountain Copper Company, Tyrone, N. M., were acquired by companies of which Dr. Douglas was president and manager. In 1908 these properties were consolidated into the fifty million dollar corporation of Phelps, Dodge & Co., of which Dr. Douglas was president. The railroad building under Dr. Douglas's management, begun in the early eighties, continued to expand with the growth of the copper companies, and at the present time under the title of the El Paso & Southwestern Railroad Company, operates over one thousand miles of standard-gauge road.

Dr. Douglas was the author of a number of books, among which were "Canadian Independence," "Quebec in the Seventeenth Century," "New England and New France," "Journals and Reminiscences of James Douglas, Sr." He also wrote very many literary and technical articles, reports, addresses, and delivered many lectures, including a series of the Cantor lectures, before the Society of Arts, of London.

Dr. Douglas was twice president of the American Institute of Mining Engineers, was the recipient of the gold medal of the Institution of Mining and Metallurgy of London and in 1915 was awarded the John Fritz medal. In 1899 McGill University conferred on him the honorary degree of LL.D. In 1916 he was elected Chancellor of Queens University, his alma mater.

In 1860 Dr. Douglas married Miss Naomi Douglas, daughter of Capt. Walter Douglas, of Quebec; six children were born, of whom the following are now living: Major James S. Douglas, Watler Douglas, Miss Elizabeth Douglas and Mrs. Edith M. Douglas.

Camphor Production and Imports

The supply of camphor will be governed by the ship cargo space available from Japan and necessary munition requirements. It is hoped that the short markets will stimulate synthetic investigations, as well as the development of this gum tree in the Americas. As is well known, pinene, the light distillate from turpentine, saturated with anhydrous hydrochloric acid gas at a low temperature, gives a solid gum product. This has been trade named artificial camphor and scientifically called pinene hydrochloride, both of which names are not well founded, the product having proven to be a camphene-chloride. As natural camphor is a ketone, the chlorine is substituted with an hydroxyl radical, the product oxidized, and actual artificial camphor produced. Perhaps hydrofluoric acid would be better than hydrochloric, the fluorine being better removed by silica compounds and the entire reactions becoming more co-ordinated and complete.

The following are the camphor imports for March periods:

1918	3,736,240 lb.
1917	7,099,423 lb.
1916	4,122,735 lb.

Our Expanding Dyestuff Industry

U. S. Tariff Commission Makes Preliminary Report on Census of Coal-Tar Products for 1917—Shows Production Exceeds Pre-War Imports—Value of Exports Exceeds Pre-War Imports

THE United States Tariff Commission announces the completion of its census of coal-tar products for 1917. This group of products includes not only the coal-tar dyes and the crude and intermediate materials required for their manufacture, but also all of the medicinal and photographic chemicals, explosives, synthetic resins, synthetic perfume materials, and flavors which are in any way derived from coal-tar products. There were produced in the United States (not inclusive of explosives and synthetic phenolic resins) 54,367,994 pounds of dyes and other finished products, which have a total value of $68,711,228. The production of the materials known as intermediates amounted to 322,650,531 pounds, with a value of $106,942,918. The annual production was reported for the following groups of products made in whole or in part from materials derived from coal tar: 45,977,246 pounds of dyes valued at $57,796,027; 5,092,558 pounds of color lakes valued at $2,764,064; 2,236,161 pounds of medicinal chemicals valued at $5,600,237; 779,416 pounds of flavors valued at $1,862,456; 263,068 pounds of photographic chemicals valued at $602,281; and 19,545 pounds of perfume materials valued at $125,960.

Value of 1917 Exports Exceeds 1914 Imports

Imports 1914	$ 9,102,066
Exports 1917	11,709,287

Tonnage of 1917 Production Exceeds 1914 Imports

Imports 1914, lb.	45,840,866
Production, 1917, lb.	45,977,246

Production and Value, 1917

	Pounds	Value
Coal Tar Dyes	45,977,246	$57,796,027
Color Lakes	5,092,558	2,764,064
Medicinal Chemicals	2,236,161	5,560,237
Flavors	779,416	1,862,456
Photo Chemicals	263,068	602,281
Perfume Materials	19,545	125,960
Total Dyes, etc.	54,367,994	$68,711,025
Intermediates	322,650,531	106,942,918

There were 81 establishments engaged in the manufacture of coal-tar dyes in 1917 and their production during that year was practically identical with the amounts annually imported before the war. The imports for the fiscal year 1914 amounted to 45,840,866 pounds and the production in the United States in 1917 was 45,977,246 pounds. However, an analysis of this total reveals that the domestic production, though equal in quantity to the preceding imports, differs in the relative amounts of the various classes of dyes. Only a small production was reported for indigo, and the alizarin and vat dyes derived from anthracene and carbazol—classes of dyes which include some of the best and fastest colors known to the textile trade. The United States produced only 2,166,887 pounds of these dyes in 1917; and the elimination of 1,876,787 pounds of extract made from imported indigo reduces the output of these dyes to less than three per cent of the pre-war imports. Dyes of this class are dutiable at 30 per cent in the Tariff Act of 1916. The lack of development in the remedied to a considerable extent in 1918, for a number of firms have begun their manufacture and a large increase in production can clearly be foreseen.

In the classes of dyes which if imported would be manufacture of these particular dyes promises to be dutiable at 30 per cent plus five cents a pound, the American manufacturers have shown remarkable progress, producing 43,810,359 pounds at a total value of $57,639,990. That this represents something of an excess over the American needs is evidenced by the fact that during the fiscal year 1917, American-made dyes to the value of $11,709,287 were exported to other countries. Thus the exports exports exceeded the pre-war imports in total value although not in tonnage nor in the variety of the dyes. The developments of the manufacture of intermediates is equally marked, for before the war almost all of these necessary materials were imported from Germany. The Tariff Commission finds that intermediates were manufactured by 117 firms in 1917 and that the production amounted to 322,650,531 pounds valued at $106,942,918. These figures, however, are somewhere misleading as there is inevitable duplication in the totals. It is well known that many of the intermediates are derived from other products of the same class. Thus starting with benzol the following succession of products is obtained: nitrobenzol, anilin, acetanilid, nitroacetanilid, and nitranlin. Each of these products had to be reported by the manufacturer and hence there has been some cumulative counting.

The totals for all of the coal-tar products will be published in the final report which may well be expected to offer accurate evidence on the progress of the American dyestuff industry.

German Institute for Metallurgical Research

About a year ago a special research laboratory was planned to promote the progress of German metallurgy with a view to the exceedingly keen competition to be anticipated after the war. The location of the research institute will be in the Rhenish-Westphalian industrial region, and the considerable funds required for the construction and maintenance will be provided largely by the iron and steel industry, which probably will be most affected.

U. S. Tariff Commission Holds Hearings on Tungsten at Denver

The meeting of the United States Tariff Commission was held in the District Court Room, Federal Building, at 10 a.m. June 17, to receive testimony from the producers of tungsten of Boulder County, Colorado, on the need of a tariff to protect their industry.

The Commission was represented by Mr. E. P. Costigan and by its Metallurgical Expert, Mr. Guy C. Riddell.

Among the operators presenting testimony were: Mr. Warren Bleecker, President of the Tungsten Products Company, Boulder. Mr. Harold Boericke of the Primos Chemical Company. Mr. William Loach of the Wolftung Mining Company. Mr. John A. McKenna of the Vasco Mining Company. Mr. John G. Clark of the Boulder Tungsten Production Company. Mr. Nelson Franklin of the Rare Metals Ore Company. Mr. William Couddrey of the Long Chance Mining Company. Mr. I. N. Bair, leaser on the Good Friday Mine. Mr. Edwin E. Chase, Mining Engineer of Denver. Mr. Emerson J. Short of the Union Mine and Development Company, Denver. Mr. Stoddard of the Black Metals Company, Boulder.

MR. WARREN F. BLEECKER presented a report signed by the operators of Boulder County through their Committee asking that they be given protection by a tariff which would raise the price of 60 per cent concentrate to $30 to $40 per unit.

The Boulder County Committee was of the opinion that the adequacy of American deposits for domestic needs is largely dependent upon the price and stability of the market. In 1917 there was produced in Boulder County from 2800 to 3000 tons of concentrates requiring the labor of approximately 750 men. At one time during the boom in 1915-1916 as many as 3000 men were directly employed in the tungsten industry in Boulder County, showing that an increase in the price causes very many more people to engage in the industry.

Mr. Bleecker then took up some of the metallurgical details of Boulder County practice, showing that an average recovery was 75 per cent, and that on the horn ores they only made 50 per cent recovery. He showed that due to the fine grind necessary to removing the gangue material there was a heavy slime loss, and stated that there was no new satisfactory process for slime recovery. He stated that whereas ferberite had always been considered the best material for the electric furnace manufacture of ferrotungsten, scheelite was now being used successfully and was commanding a premium for this work which formerly had been commanded by ferberite. He stated that the high phosphorus on the Boulder County concentrate compelled the refining process which was not necessary with scheelite. He felt that there has been much misinformation spread as to the impurity of foreign ores, as most of the foreign ores were as pure as our ore. He felt that a price of $30 to $40 per unit should be established for 60 per cent tungsten concentrate.

MR. NELSON FRANKLIN of the Rare Metals Ore Company gave some typical figures of actual expenditures in the production of 60 per cent concentrate from the mining operations of the Tip-Top Leasing Company and the Black Metals Mining Company. These were the only

COST OF PRODUCING TUNGSTEN CONCENTRATE
THE BLACK METAL MINES COMPANY
STATEMENT OF PRODUCTION COST, 1917

	Total Expenditures	Production: Tons	Per Cent. WO_3	Units WO_3	Cost Per Unit
Brace tract	$4,406.26	10.75	1.03	11	......
Manchester	19,224.18	1,210.0	1.88	2,280	......
Whitney	1,562.40	....	.....	.....	......
Pactolas	83.49	....	.....	.....	......
Comet	113.14	....	.....	.....	......
Bishop	2,384.80	....	.....	.....	......
Ecker	1,524.51	2.08	1.84	4	......
Total	$29,298.78	1,222.83	Avge. 1.876	2,295	......
Total Units Produced			2.295		
Less 20% loss in milling			0.459		
Net units recovered			1.836		
Less 20% royalty to owners of property			0.367		
Net units recovered for sale by us			1.469 =		$19.82
Hauling charges on 1,222.83 tons @ $2.00 = $2,445.86					1.33
Milling charges on 1,222.83 tons @ 6.00 = 7,336.98					3.99
Total cost per unit produced					$25.14

The royalty is based on the recovery in concentrates and owners of the properties under lease pay their proportion of the hauling and milling charges, hence these costs are divided by the net recovery in concentrates from the mill, whereas the net cost to us is based on the net recovery by us on our proportion of the recovery in concentrates.

THE TIP TOP LEASING COMPANY
STATEMENT OF PRODUCTION COST 1917 AND 1918

Total expenditures $25,220.84

We have been developing the mine during the winter and on account of snow being very deep could not commence to haul ore to the mill until June 10th.

Our engineers estimate that we have 2,000 tons of ore developed, of an average grade of 1.10% WO_3.

		Cost per net unit produced for sale by us
2,000 tons @ 1.10%	2.200 units	
Less loss in milling 20%	0.440 units	
Net units recovered	1.760 units	
15% royalty to owners' property	0.264 units	
Net units recovered by us for sale	1.496 units	$16.86
Mining cost yet to extract ore 1,800 tons, $4.00 per ton,	$7,200.00 =	3.63
Hauling charges on 2,000 tons @ $4.00	8,000.00 =	4.54
Milling 2,000 tons @ $6.00	12,000.00 =	6.81
Total cost per unit produced		$31.84

The royalty of 15% is based on the recovery in concentrates and the owner of the property has to pay his proportion of the hauling and milling charges, hence these costs are divided by the net recovery in concentrates from the mill, whereas the net cost to us is based on the net recovery by us on our porportion of the recovery in concentrates.

COST OF MANUFACTURE FERROTUNGSTEN,
FERRO ALLOY COMPANY, JUNE, 1917

		Pounds
Concentrate smelted		19,520.00
Tungsten contained		9,325.4
Ferrotungsten produced		10,095.00
Tungsten contained in ferrotungsten	7,167.45 lb.	
Tungsten contained in residues	962.00 lb.	
Total recovered tungsten	8,129.45 lb.	8,125.45
Percentage recovery of tungsten		87.1
Ferrotungsten on hand June 30th		15,185.00
Tungsten contained in ferrotungsten on hand		10,781.35
Tungsten contained in residues		962.00
Total tungsten on hand		11,743.35

COST OF MANUFACTURE OF FERROTUNGSTEN, JUNE, 1917. BASED ON A PRODUCTION OF 10,095 LB. FERROTUNGSTEN, CONTAINING 7,167.45 LB. W.

		Total	Per Pound Tungsten
Supervision		$290.00	$0.040
Laboratory expense—chemist	$72.50		
supplies	22.06	94.56	1.014
Labor		609.60	0.085
Power, 59,346 kw.-hr., cost 0.73 cents		432.60	0.060
Supplies:			
Electrodes		131.69	0.018
Refractories		146.42	0.021
Miscellaneous		25.00	0.003
Charge—fluxes, etc.		53.86	0.008
Tools		58.00	0.008
Repairs and renewals		77.40	0.011
Sales expense		37.14	0.005
Office		82.05	0.012
Insurance		43.26	0.006
Total operating		$2,081.58	$0.291
Ore cost—charged to FeW	$11,647.06	....	....
Less residues*	1,102.50	$10,544.56	$1.475
Total		$12,626.14	$1.766

* Tungsten in residues credited at $1.25 per lb. W, which was cost with $20 concentrate.

This cost statement includes all costs up to sale, packing, and shipment from plant. Adding these items gives cost f. o. b. New York:

f. o. b. plant, operating cost	$0.291
f. o. b. N. Y., additional cost	0.090
Ore cost	1.475
Total cost sold and delivered New York, per lb. W...	$1.856

actual cost figures drawn from the ledger made public at the meeting, although other figures were given as confidential for the use of the Tariff Commission. Copy of these costs is presented herewith.

MR. EDWIN E. CHASE stated that the Good Friday Mine was under lease to I. N. Bair, and that although this mine had one of the best showings of tungsten in the district it could not operate at a profit with concentrate at $22 to $25 per unit. In reply to question from the Tariff Commission he stated that he didn't believe that the tungsten resources of Boulder County were by any means exhausted, but that the easily reached deposits were worked out.

MR. EMERSON J. SHORT produced figures attempting to show that all of the profit in tungsten operations was obtained by the mill-man and the ferrotungsten manufacturer. He claimed that the cost of the production of ferrotungsten for operating expenses, but not including the price of ore, was 14¾c. per pound of W contained, and that the power cost was approximately 1½c. per pound of W contained. His figures on milling were much lower than those stated by others present.

MR. R. M. KEENEY of The Ferro Alloy Company produced actual cost figures on the manufacture of ferrotungsten showing a cost of about 38.1c. per pound of W for ferrotungsten delivered in New York. These figures include the entire operating expense and express to New York. He also stated that the Ferro Alloy Company ceased its operations on the manufacture of ferrotungsten and converted its plant into a ferrochrome plant last July because of the fact that at that time tungsten concentrate went to $27.50 per unit with ferrotungsten remaining from $2.15 to $2.25 per pound of contained tungsten. The concentrate cost, under these conditions, was $2 per pound, which with an operating cost of 38c. per pound made a total cost of $2.38 per pound. These figures were corroborated by another producer present. A copy of the cost of the manufacture of ferrotungsten by the Ferro Alloy Company, June, 1917, is given herewith.

A representative of the Miners' Union from Nederland, Colorado, who was also a leaser, stated that the miners were not getting enough pay; that instead of a $4 a day minimum they should get $5 a day minimum. However, he said that, as a leaser, he could not afford to pay any higher wages as he had a very close margin of profit with present wages, and felt that the only way to get higher wages was to put the price of tungsten concentrate up to $30 to $35 per unit. He felt that rather than establish the price of concentrate on the basis of 60 per cent, some means should be taken to arrange a definite schedule for ores from 1½ up to 60 per cent, as he felt that the miners never knew what price they were going to get for concentrate until it was shipped to the mill and that the mill did not pay them a high enough price. Several present showed that the mill was paying all that it could afford to pay, but there was a general consensus of opinion that rather than establish a price of concentrate the price should be established on certain grades of ore so that the miner could look forward to a fixed price. Part of this testimony was considered by the Tariff Commission to be evidence more for the fixation of a price on tungsten rather than showing the need of a tariff to protect the producer of ore.

Water-Power Committee Agrees on Bill

THE special committee appointed in the House of Representatives to consider all proposals for water-power legislation has completed its work and has agreed upon a bill which will be presented to Congress probably early in July. The bill is practically identical with what was known as the Administration Water Power Bill which was made the subject of hearings that have been previously reported[1].

In its essential features the bill provides for a Federal Power Commission consisting of the Secretaries of War, Agriculture and the Interior. The President is to designate the chairman of the commission, which is to issue licenses for the development of water power projects, the term of the license to be not exceeding 50 years.

The original definition of net investment is retained. The bill also contains the original options regarding the disposition of the project at the end of the 50-year license period, and relating to the regulation of rates of service and character of securities.

A new provision was written into the bill requiring the licensee to maintain out of surplus earnings, if any, accumulated in excess of a specified rate of return upon the net investment, amortization reserves to be held until the termination of the license or applied periodically in reduction of the net investment. The license may provide that any balance or surplus earnings shall be used in reduction of rates and annually returned to the consumer.

Steel Prices Fixed for Three Months

The President has approved the agreement made by the Price-Fixing Committee of the War Industries Board with the representatives of the iron ore, pig iron and steel interests, that the maximum prices now prevailing on iron ore, pig iron and iron and steel products be continued in effect for the three months ending September 30, 1918, with the following exceptions:

1. Lake Superior iron ore:

Base prices of Lake Superior iron ore delivered to lower Lake ports are increased 45c. per gross ton on and after July 1, 1918, subject to the following condition: These increased prices are based on the advances in rail freight rates effected June 25, 1918, and on the present lake rates and in the event of any increase or decrease in either rail or lake rates said prices shall be increased or decreased accordingly on all deliveries made during the continuance of such increased or decreased freight rates.

2. On and after July 1, 1918, the basing point for steel bars, shapes and plates will be Pittsburgh, Pa.

No new contracts calling for delivery of any of the above commodities or articles on or after Oct. 1, 1918, are to specify a price unless coupled with a clause making the price subject to revision by any authorized United States Government agency, so that all deliveries after that date shall not exceed the maximum price then in force, although ordered or contracted for in the meantime. It is expected that all manufacturers and producers will observe the maximum prices now fixed.

[1]This journal, Vol. XVIII, No. 5, (Mar. 1, 1918, p. 225), oN. 6, (Mar. 15, 1918, p. 286), No. 7, (Apr. 1, 1918, p. 339), No. 9, (May 1, 1918, p. 439), and No. 11, (June 1, 1918, p. 568).

The President's Readjustment and Reconstruction Commission—II.

Elaborate Preparations Already Made by England's Ministry of Reconstruction

By Wingrove Bathon
Washington Representative, McGraw-Hill Co., Inc.

THE previous article in this series suggested and urged the appointment by the President of the United States of a readjustment and reconstruction commission, to begin to deal now with vital problems in industry which will be presented after the war. It was pointed out that many other countries, notably Great Britain, have already begun to attempt to solve after-the-war problems. The personnel of a suitable commission, selected from the ranks of American industry, and of an advisory council, taken from the ranks of Government officials, to work with such a commission, was suggested in detail.

Some of the far-reaching work being done along this line by Great Britain is now presented as an evidence that it is necessary for American industry to begin now to prepare to solve after-the-war problems. This description of Great Britain's Ministry of Reconstruction is taken from the official reports to Parliament of the British War Cabinet, furnished to the writer for the purpose of this article by Arthur Willert, Secretary of the British War Mission at Washington. These reports are inclusive of the year 1917 and have just been sent to Washington.

British Ministry of Reconstruction

After tracing the earlier stages of the Ministry of Reconstruction in Great Britain, before it was established by the New Ministries Act, in July, 1917, and when the agency of reconstruction consisted of a committee of Ministers of the Crown, the War Cabinet reported that it was found necessary to establish a Ministry of Reconstruction to continue for the duration of the war and for a period of two years, or less, after its conclusion. It was declared that a Prime Minister upon whose shoulders fell the responsibility for the conduct of the war could not personally assume a day-to-day responsibility for guiding the Reconstruction Committee's work. It was stated that the Government had throughout been aware that as the war continued, and its pressure upon every side of the national life increased, the intensity of the struggle in itself enhanced the importance of the reconstruction problems which had to be faced; and that Parliament and the country were not slow in realizing that there was coming into existence a series of questions of the utmost importance to which answers must be found, not after, but before, the conclusion of the war.

The functions of the Minister of Reconstruction then appointed and who assumed office in August, 1917, are defined as follows:

"To consider and advise upon the problems which may arise out of the present war and may have to be dealt with upon its termination, and for the purposes aforesaid to institute and conduct such inquiries, prepare such schemes, and make such recommendations as he sees fit; and the Minister of Reconstruction shall, for the purposes aforesaid, have such powers and duties of any Government department or authority which have been conferred by or under any statute as His Majesty may by Order in Council authorize the Minister to exercise or perform concurrently with, or in consultation with, the Government department or authority concerned."

In other words, as was brought about during the debate which resulted in the creation of the Ministry, the Minister in charge does not exercise executive functions; he appoints committees; he initiates experiments; he frames schemes for action with a view to conditions after the war; his powers are not exclusive and do not shut out other departments; he assists the other departments, provides them with information and helps them "to build a bridge which will safely carry us over from war to peace conditions." The British Parliament found that the creation of a reconstruction agency was desirable because various government departments are approaching various problems in their own way, each drawing up reports or memoranda, and that what was needed was a co-ordinating element, not especially attached to the work or to the traditions of any one of the departments concerned. The Solicitor-General of Great Britain, speaking in debate, said that what was needed was a "comprehensive co-ordinating mind, a fresh mind, and at the same time an authoritative mind, who will bring together the several contributions of the various specialized departments."

Branches of the British Ministry

The Ministry of Reconstruction was then formed. For the purposes of administration the department was divided into branches dealing respectively with Commerce and Production, including the supply of materials; with Finance, Shipping and Common Services; with Labor and Industrial Organization; with Rural Development; with the Machinery of Government (Central and Local); Health and Education; and with Housing and Internal Transport.

The Minister of Construction then appointed an Advisory Council, "representative of all the leading interests concerned in reconstruction, and it is his hope by consulting the Council freely and regularly to secure a representative consensus of opinion on any proposal which may be referred to him for advice or which may be initiated in the department." This Council is organized very much as the Pan American Financial Conference held in Washington at the beginning of the war was organized, and very much as the old War Industries Board of the Council of National Defense of the United States was organized. In other words, there are experts in each line named to serve the government representatives. The Council is divided into sections, just as the administration of the Ministry of Reconstruction is divided. It is stated that " the membership of the Council has been so arranged that in each section all the principal interests represented on the Council should find a place; thus, there are representatives of labor on the finance section as well as financiers; there are business men as well as agriculturists on the section dealing with agriculture; and so on."

The meetings of the sections of the Ministry and the Council are private, but it is known that they have already dealt with the standardization of railway equipment; the post-war rationing of industries; the establishment and functions of trade organizations; the or-

ganization of rural information centers; the establishment of industrial courts; house planning from the point of view of domestic economy; the future organization of voluntary women's work; and the conditions required for maintaining a supply of efficient agricultural labor.

Work Already Accomplished by Different Sections

The section dealing with commerce and production is investigating (1) the supply and control of raw materials after the war; (2) financial facilities for British commerce and industry after the war; (3) the preservation of industries which will play an essential part in reconstruction but are in extinction through failure of supplies of material or labor; (4) financial risks attached to the holding of trading stocks; (5) trusts and combinations with special reference to the protection of the consumer; (6) the establishment of new industries after the war, a committee having been especially appointed to consider this question as far as the engineering industries are concerned, a parallel committee considering the labor questions involved; (7) the volume and nature of the demand for British goods after the war; and (8) improvements in trade organization for the purpose of more economical production, distribution, and marketing, and expediting the turnover from war to peace.

The section dealing with finance, shipping and common services is, in conjunction with the Treasury, considering the question of currency and exchange after the war; and under this section an Advisory Council section is at work on the disposal of government stores after the war.

Conference of Trade Organizations

The section dealing with labor and industrial organizations has agreed with the British Board of Trade and the Ministry of Labor that "a concerted effort should be made to promote in as many industries as possible representative organizations to advise the Government as to the views and needs of the industries on the various industrial and commercial problems that will affect them during the reconstruction period. The Ministry of Labor is to proceed with the formation of permanent industrial councils. A conference of trade organizations is being established by the Ministry of Reconstruction, consisting of three employers, three trade unionists and representatives of the Board of Trade, the Ministry of Labor and the Ministry of Reconstruction. The Minister of Reconstruction has decided to refer to the Industrial Section of the Advisory Council the question of establishing corresponding organizations in engineering and in railways.

This section, (dealing with labor and industrial organizations) is farther along with its work than any of the other sections, apparently; for reports have been submitted on unorganized trades and works, and, probably by now, on conciliation and arbitrations. A general survey of industrial policy as a whole has been prepared, going into the law and labor in merchant shipping, war-time departures from trade-union practices, industrial courts, industrial structures, apprenticeship, the reinstatement of returning soldiers and sailors and international labor legislation. Furthermore, surveys have been undertaken of industrial methods; inquiry is being made into juvenile employment; the question of army demobilization, it has been settled, makes the Ministry of Labor responsible for the returned soldier or sailor, and the Ministry of Reconstruction is to determine the priority of different trades. A complete list of public works which have fallen into arrears has been prepared so that surplus labor may be usefully and rapidly employed; and the Ministry of Munitions has begun work on the special problems arising out of its work.

Rural Development Being Studied

The section dealing with rural development is examining (1) the working of the Small Holdings Act and the future of Urban War Allotments; (2) a report made by the Forestry Committee; (3) the rural housing problems; (4) the organization of County Offices for advice on agriculture; (5) tithe redemptions; (6) village industries; and (7) the report of the Land Acquisition Committee.

The section dealing with Machinery of Government, Health, Education, etc., is negotiating through a committee on the distribution of functions in regard to the formation of a Ministry of Health and is studying reports which have been made (1) on the functions of the Poor Law Authorities; and (2) on Adult Education.

The section dealing with Housing and Internal Transport, with a view to facilitating work in connection with housing, has set to work committees on (1) supply of building materials; (2) house building construction and on (3) building by-laws. Special investigations are being made by this section on (1) control of public utility societies; (2) town planning; (3) rings in the building trade; (4) the working of the Small Dwellings Acquisition Act; and a general review of the problem of inland transport is being made, the portions dealing with roads and canals having been completed. Furthermore, the Ministry is in consultation with the Board of Trade concerning the future of the railways (including light railways) of Great Britain and an inquiry has been begun into the question of storage and distribution as essential elements in transport policy.

Shortage of Materials and Tonnage After the War

This article is intended to be but a brief outline sketch of the monumental amount of work being done by the British Ministry of Reconstruction, but it might be well here to hark back for a moment or two to some of the points being taken up by the various sections. In the section dealing with commerce and production, the report of the British War Cabinet to Parliament states that the question of the "volume and nature of the demand for British goods after the war" and the question of "improvements in Trade Organization for the purposes of more economical production, distribution and marketing and of facilitating the turnover from war to peace" are being handled in consultation with the British Board of Trade and the Department of Overseas Trade, and that "a comprehensive scheme of work has been prepared." The British Cabinet thus states the problem.

"After the war there will be a world shortage of certain materials and the shortage will be accentuated by the difficulty of finding tonnage adequate to our demands. On the other hand, there will be an almost unlimited demand for manufactured goods."

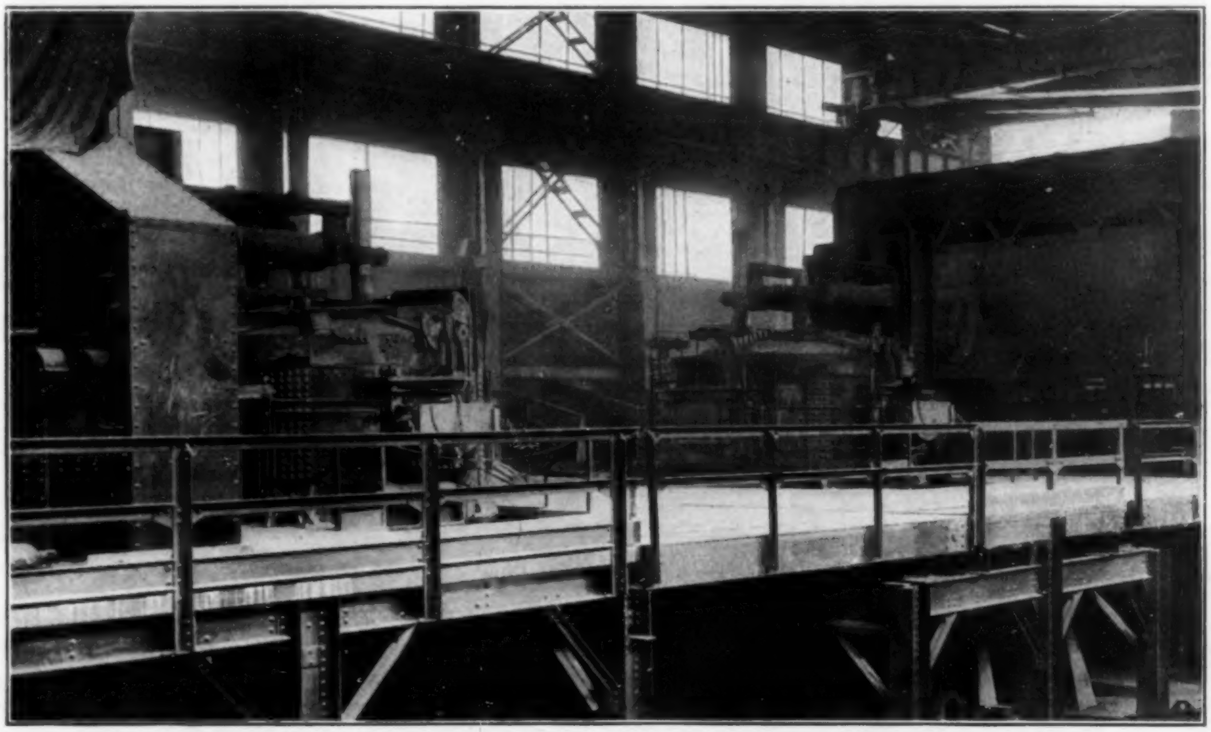
Triplex Process of Making Electric Steel*

Development at South Chicago of the World's Largest Electric Steel Plant Comprising Three 25-ton Heroult Furnaces—Superiority of Electric Steel—Increase in Production in Ten Years

By THEODORE W. ROBINSON

THE development of electric steel at South Chicago was based upon the fundamental conception that the electric furnace was pre-eminently adapted to the manufacture of carbon and alloy steel of the highest quality, that it would be possible to produce electric steel in sufficiently large units to permit its use in heavy products, and that the increasing demand for high-grade steel would provide a sufficiently extensive market to make its manufacture commercially possible.

Under these promises, the Illinois Steel Co., in May, 1909, installed its first electric steel furnaces at the South Chicago works. At that time there were only two other electric furnaces in this country concerned with the manufacture of electric steel—one at the Halcomb Steel Co., Syracuse, N. Y., and the other at the Firth Sterling Steel Co., McKeesport, Pa. The furnaces here and abroad were all small, running from a ton or less to five tons in capacity. Our installation consisted of a 15-ton basic-lined Heroult furnace with an electric equipment for 3-phase, 25-cycle, and 100-ton volt current. The manufacture of electric steel was a new art and ours was a new adaptation of a new art. As to the troubles we encountered, I may say their name was "Legion." Perseverance conquered, however, and we soon had the satisfaction of producing a metal of unquestionably superior quality.



TWO OF THE THREE 25-TON HEROULT ELECTRIC FURNACES

As the fundamental object was to demonstrate the opportunities of the new process in connection with heavy products, attention was early turned to the experimental manufacture of electric steel rails. Under the limitation of equipment, it was necessary to depart from standard rail practice to the extent of accumulating cold ingots and re-heating them. The electric steel used was made from Bessemer blown metal. We advisedly felt our way in chemistry. Irregularities incident to incomplete equipment were unavoidable. In spite of pioneering difficulties, about 10,500 tons of electric steel rail were laid on 14 railroads throughout the country. The result of these rails in track indicated that electric and openhearth rails of like chemical composition had practically the same resistance to wear when the former were made under the conditions that existed at the time of their manufacture. The failure from breakage was almost negligible, there were no interior defects and the tests showed that the electric steel was considerably more ductile at low temperature than either the openhearth or the Bessemer steel.

In order to further determine the facts, a series of experiments was undertaken with a view of testing the ductility of rail steel at low temperatures. A refrigerating plant was erected adjacent to our regular drop-testing machine. About 900 pieces of electric, openhearth, and Bessemer rails of various sections were tested at temperatures ranging from 70 deg. Fahr. to

*Excerpt of a paper presented at the fourteenth general meeting of the American Iron and Steel Institute in New York, May 31, 1918. The author is first vice-president of the Illinois Steel Co.

50 deg. below zero. These tests emphasized that, in the case of all the steels, there was a marked decrease in resistance to shock as the temperature lowered. Relatively speaking, however, the electric steel was distinctly more ductile than either the Bessemer or openhearth. The following summary from two electric and two openhearth heats of similar analysis involving 242 tests is typical of the general results obtained. The figures in Tables II, III and IV are average results. The chemical composition of the heats is given in Table I.

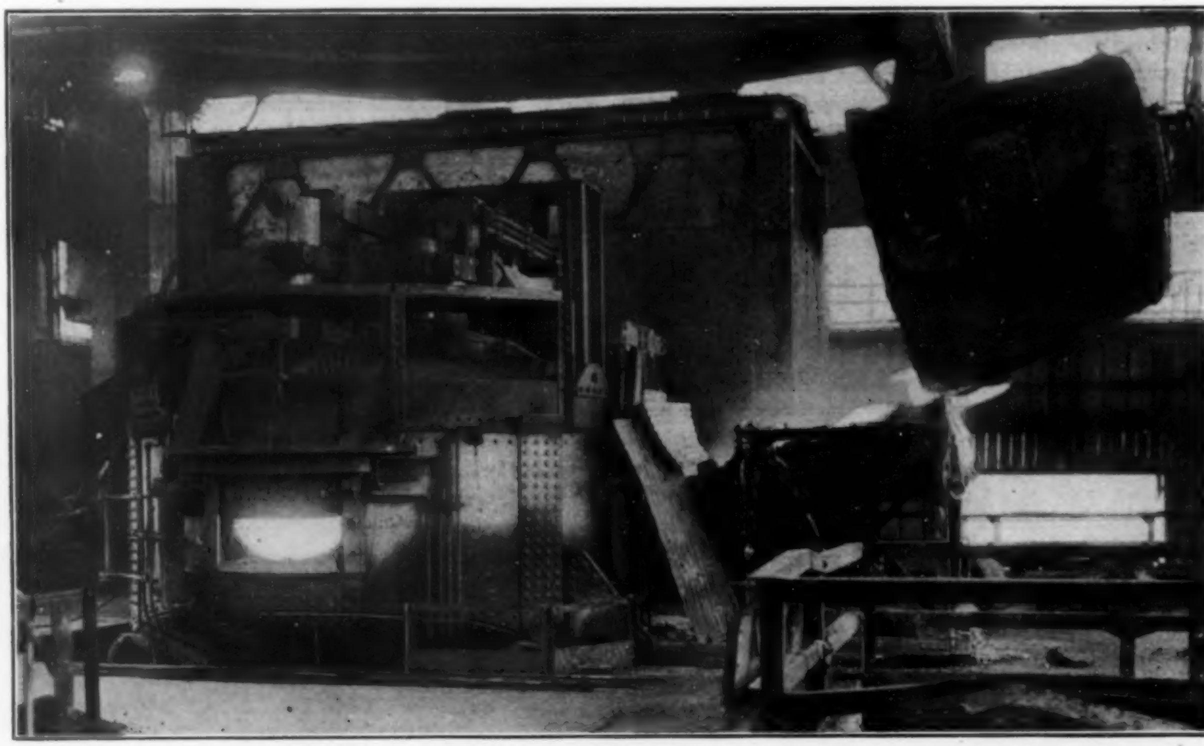
In all these tests the height of drop was kept comparative. At normal temperatures 18 ft. was employed. At zero Fahrenheit and below, the steel, weakened by the cold, could not withstand so heavy a blow, and the drop was reduced to 8 ft. While it is self-evident that the number of heats involved in the above tables is entirely too small to permit the drawing of definite conclusions, the fact that the other drop tests and the result of the rails in track all pointed in the same direction warrants the belief that the resistance to dynamic force rapidly decreases with lower temperature in the case of both openhearth and electric steels and that electric steel is tougher than openhearth steel at low temperatures.

During and after the period in which we were manufacturing electric steel rails, we were experimenting with such other heavy products as forgings, plates, axles, and structural shapes. Not only had carbon steel been made in relatively large quantities in connection with these products, but the field of alloy steel had been comprehensively entered. Expanding demand led to the introduction in July, 1916, of a second furnace, similar to the original one in electrical equipment and capacity. This gave a combined capacity of about 4500 tons of electric steel ingots per month.

Large Electric Furnaces Justified

By this time our experience had verified in a large measure the soundness of the views upon which our original electric furnace installation was predicated. We had demonstrated that it was possible to produce electric steel in relatively large units without the sacrifice of quality. The physical characteristics of the steel had proved to be admirably adapted for heavy products. There was a growing demand for a superior steel for general purposes, and the call for alloy steels was rapidly increasing in connection with the automobile and other industries. Extent of market was largely a question of price, and price logically was largely a matter of cost.

In the meantime an addition to our openhearth at



POURING OPEN-HEARTH METAL INTO ONE OF THE 25-TON HEROULT ELECTRIC FURNACES

TABLE I.—COMPOSITION OF THE RAIL STEELS

	Carbon, Per Cent	Manganese, Per Cent	Phosphorus, Per Cent	Sulphur, Per Cent	Silicon, Per Cent
First electric heat......	0.64	0.60	0.024	0.019	0.216
First open-hearth heat..	0.62	0.71	0.020	0.040	0.140
Second electric heat.....	0.73	0.90	0.022	0.043	0.256
Second open-hearth heat	0.72	0.88	0.035	0.033	0.200

TABLE II.—AVERAGE NUMBER OF BLOWS REQUIRED TO BREAK THE RAILS

Temperature	Electric	Open-Hearth	Comparison
*+60 deg. F.	3.48	3.64	O. H. 5% over Elect.
0 deg. F.	4.41	3.82	Elect. 15% over O. H.
—30 deg. F.	4.55	2.24	Elect. 103% over O. H.
—40 deg. F.	3.31	2.03	Elect. 65% over O. H.

TABLE III.—DEFLECTION BEFORE BREAKING BLOW

Temperature	Electric	Open-Hearth	Comparison
*+60 deg. F.	2.96 in.	3.36 in.	O. H. 14% over Elect.
0 deg. F.	1.41 in.	1.23 in.	Elect. 15% over O. H.
—30 deg. F.	1.46 in.	0.58 in.	Elect. 152% over O. H.
—40 deg. F.	0.91 in.	0.43 in.	Elect. 112% over O. H.

TABLE IV.—ELONGATION IN 12 INCHES MEASURED AFTER LAST BLOW BEFORE THE DESTRUCTION

Temperature	Electric	Open-Hearth	Comparison
*+60 deg. F.	0.808 in.	0.929 in.	O. H. 15% over Elect.
0 deg. F.	0.404 in.	0.397 in.	Elect. 2% over O. H.
—30 deg. F.	0.420 in.	0.201 in.	Elect. 109% over O. H.
—40 deg. F.	0.297 in.	0.141 in.	Elect. 111% over O. H.

* 60 deg. F.—18 ft. drop. Zero deg. F. and below—8 ft. drop.

South Works had become desirable and in connection therewith the matter of increasing our electric steel capacity was taken under consideration. In studying this subject, we were naturally guided by our past experience. We had made electric steel by the melting of cold stock. We had refined in the electric furnace both molten blown Bessemer metal and molten openhearth metal. We also had made steel by the initial refining of Bessemer blown metal in the openhearth, supplemented by final refining in the electric furnace. Part of this work was experimental in character. None of it was done under ideal economic conditions. The cost of producing steel in the electric furnace was vitally influenced, of course, by the amount of power used, and this and other conversion items were in turn largely influenced by the tonnage produced. Manifestly nothing could be considered that would sacrifice quality for output without destroying the very essence and reason for the electric process.

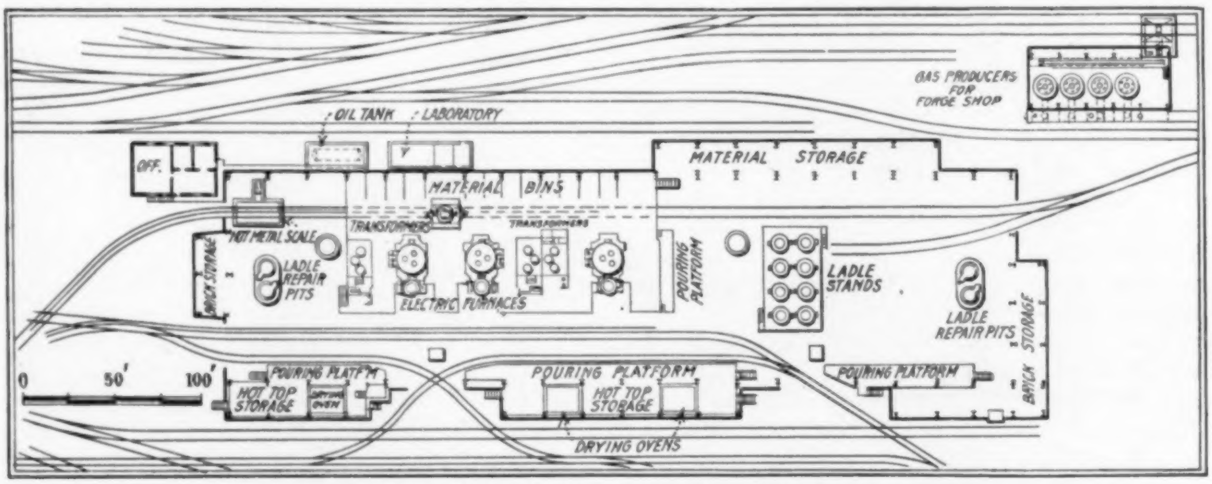
As electricity is an expensive metallurgical fuel, the melting of cold stock or the preliminary refining of metal in the electric furnace could be accomplished only at the expense of a comparatively high fuel cost. Our original practice was to make electric steel by refining Bessemer blown metal. This process necessitated two distinct operations in the electric furnace, namely, dephosphorization by the use of an oxidizing slag, and deoxidization by means of a reducing slag. Steel of the highest quality can be produced by this practice, but there is obviously greater liability to irregularity in this method than when openhearth metal is used from which the phosphorous previously has been eliminated.

It is well to remember that the electric furnace, while a highly efficient instrument, is far from fool-proof. Several years' experience with the use of Bessemer blown metal in the stationary openhearth furnaces under the local conditions that existed had helped to demonstrate the advantages of the duplex process for producing openhearth steel. It likewise had been shown that electric steel could be most advantageously produced at South Chicago by using openhearth metal.

It was essential that the proposed plant should be so designed as to provide not only Bessemer metal for openhearth refining and openhearth metal for electric refining, but Bessemer ingots and openhearth ingots as well. Many new problems were involved. It was clear that for the simultaneous production of Bessemer, openhearth and electric steel, extreme elasticity of operation was fundamental if efficiency was to be attained. Close assembly of the various units was essential for rapid and economical practice. The sequence of operation had to be unobstructed. A supply of hot pig metal and preliminary refined molten steel must be provided. The plant as finally designed, both in respect to its general plant location and its general details of construction, is shown by illustrations.

Inasmuch as this paper deals specifically with electric steel, no attempt will be made to give a detailed description of the Bessemer and openhearth refining as carried out in the new plant at South Chicago. The metallurgy and manipulation present little that is novel.

There are two main buildings; one comprising the duplex plant proper, and the other, parallel thereto, containing the electric furnaces. As an adjunct to the latter, there was installed a 1500-ton forge press. In its essential features, the duplex plant consists of two mixers, one of 100 tons and one of 300 tons capacity; two 25-ton acid-lined converters, and three 250-ton tilting openhearth furnaces. The mixers are commanded by two cranes, one of 100-tons and one of 75-tons capacity, and the mixer metal is transferred on an elevated platform to the converters by a 25-ton transfer ladle operated by cable and winch mechanism.



THE ELECTRIC FURNACE DEPARTMENT OF THE TRIPLEXING PLANT

When used in the openhearth furnaces, two heats of Bessemer blown metal are poured into a 65-ton ladle commanded by a narrow-gage locomotive. Elimination of slag is accomplished by nozzle pouring into a second ladle. When Bessemer ingots are to be produced, the metal from one vessel is poured into a smaller ladle and transferred to the Bessemer pouring platform. The three tilting openhearth furnaces, each of which has a hearth area of 892 sq. ft., are electrically operated, and are so constructed as to be heated either with producer gas or with tar. Air chambers having 10,472 cu. ft. of checker volume and gas chambers having 6734 cu. ft. of checker volume provide liberal regenerative capacity. Two low-type 7½-ton charging machines and three 100-ton overhead cranes assure the rapid handling of material. The pit side of the openhearth department, which is generous in its dimensions, is served by two 175-ton cranes, and is provided with a 330-ft. pouring platform capable of handling two sets of molds.

The Bessemer plant is designed for the ultimate addition of a third vessel. Its present capacity may be conservatively placed at 75,000 tons per month of blown metal, Bessemer ingots or any desired combination of the two. The three tilting openhearth furnaces when operating on blown metal are rated at 65,000 to 75,000 tons per month. The elasticity of their operation is self-evident, and it is obvious that their actual tonnage is dependent upon the character of the charge used. At the present time two of these furnaces are running on openhearth material, with Bessemer blown metal as a base. The other furnace is operating on a nickel steel scrap charge with molten pig iron additions for further refining in the electric furnace.

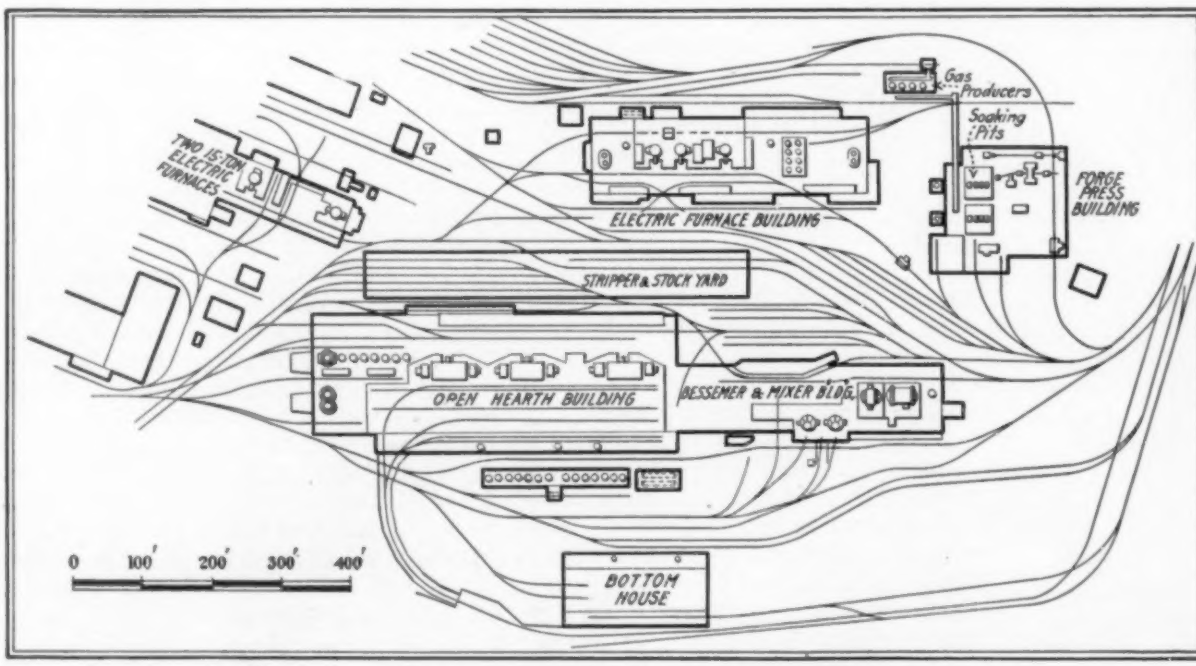
In transferring openhearth metal to the electric furnaces, it is the aim to have the metal slightly lower in carbon and manganese than the specifications under which the electric steel is to be made. There is, of course, ofttimes a wide range in the specifications under which the electric furnaces are operating, involving high and low carbon and various alloy steels.

Three 25-Ton Heroult Furnaces

The new electric plant contains three 25-ton Heroult furnaces, each with an adjacent transformer building. The general design and dimensions are shown by one of the illustrations. The capacity of the plant naturally is somewhat dependent upon the character of the steel made, but may be placed approximately at 12,000 tons per month. This with the output of the two old furnaces gives a total electric steel capacity of 16,000 to 17,000 tons per month, and makes the South Chicago works the world's largest electric steel producing plant.

The advancement in the design and operation of electric furnaces has not necessitated any radical change in the original electrical scheme as a whole. Such improvements as have been made have been rather in the nature of refinement than essential change. In the case of the large electric furnaces, it is more necessary than in the small furnace to consider the losses due to reactance in the electrical current. When we consider the relatively little power required by the original furnaces, it is evident that in the case of our larger furnaces which are equipped with transformers of 3750 kva. capacity, the question of power losses is an important one. In respect to the electric furnace load from the central station standpoint, it is interesting to note that with four furnaces operating on the triplex process, 24-hr. load factors of 75 or 80 per cent are not unusual. This compares favorably with other forms of industrial load.

In our practice, the furnaces ordinarily are operated with only a reducing slag, and care is taken at all times to see that such conditions obtain as will most thoroughly and quickly effect complete deoxidation. After the steel is thoroughly dead-melted and the reactions are complete as determined by the careful testing of the slag and metal, the current is reduced until a proper pouring temperature is obtained.



THE TRIPLEXING PLANT OF THE ILLINOIS STEEL CO., SOUTH CHICAGO

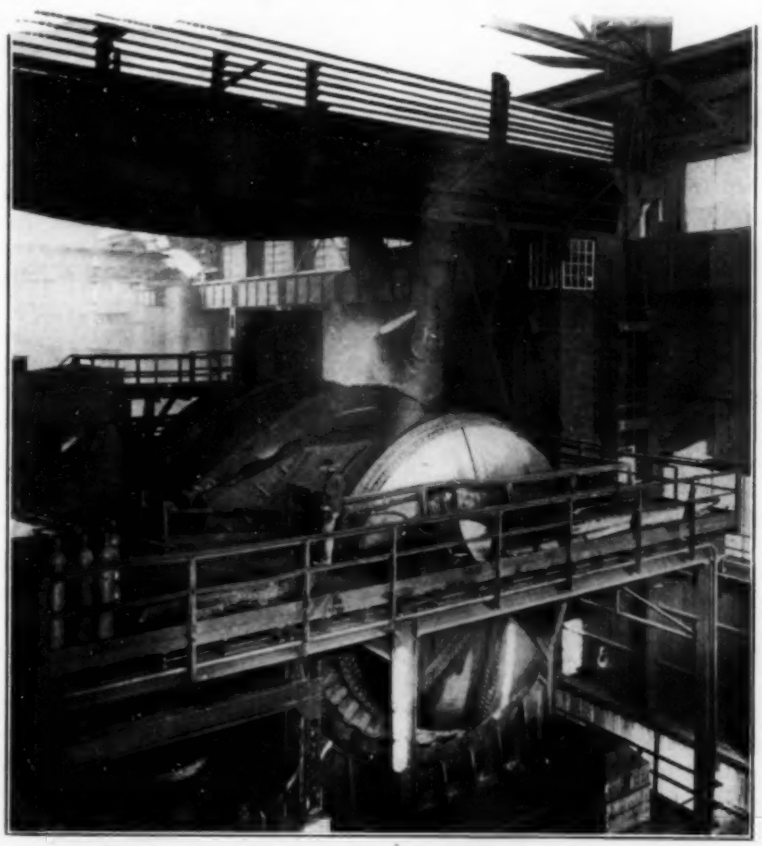
Pyrometric Control of Temperatures

The pouring of steel from the electric furnace is subject at all times to the careful control of pyrometric observation. For the production of a satisfactory steel, a proper casting temperature is an important element in all processes, but with the electric furnace special care is needed, partially because of the high heats obtainable with the electric arc. Electric steel on account of its freedom from gases is specifically a dense steel, and in metal of this character the pipe tends to be exaggerated. It is our custom to teem all electric steel in inverted molds with refractory hot tops. As a result, little difficulty is encountered either with the piping as usually found in the ordinary ingot.

As to alloy steels, it is very necessary to guard against any condition that will unduly tend to unequal ingot strains and special precautions are taken to avoid undue surface tension in the molds. We are now cast-

ing ingots weighing from 3400 lb. to 38,000 lb., the uniform solidification of which is made the subject of the greatest care. Top pouring, box pouring and bottom pouring are resorted to, as the individual character of the steel best appears to warrant, and the entraining and inclusion of slag or other foreign matter is carefully guarded against.

To one familiar merely with the casting methods in vogue with ordinary openhearth or Bessemer steel, the pit practice incident to the proper manufacture of electric steel is something of a revelation. In the subsequent work to which the ingot is subjected, whether in the forge or in the rolling mill, special precautions are taken in the heating, in the reduction of the metal and in the cooling of the product. Ordinary mill practice will by no means suffice if proper results are to be obtained, especially when alloy steels are concerned. Steel which may be innately of the highest quality when tapped in the ladle may readily retrograde or become unfit unless there is exercised extreme care in its later manipulation. Quality is peculiarly the *sine qua non* of electric steel and the price of success is eternal vigilance. There is of course nothing occult nor mysterious in the electric method, although there is more or less misconception concerning the production of electric steel. The electric furnace when used for the manufacture of steel may be likened to a large crucible heated from within instead of from without by the electric arc. It is capable of performing not only the functions of the openhearth but very largely those of the crucible as well. Its superiority lies in the rare purity of the heat derived from the electric current and in the peculiar slag control that can be commended in a neutral atmosphere.



POURING PIG IRON INTO THE 1300-TON MIXER AT THE ILLINOIS STEEL CO.'S TRIPLEXING PLANT

Superiority of Electric Steel

Both the Bessemer and the openhearth processes are distinct in their physical and metallurgical character. The electric process may likewise be considered as distinct when concerned with the manufacture of steel directly from cold metal. When, however, it is used to finish metal which previously has been made in the Bessemer or openhearth, it may be considered as supplementary to standard methods rather than as an independent process. Other than as manufactured in the smaller and perhaps more ephemeral installations, electric steel is to-day, and probably will be in the future, largely produced by a duplex or triplex process whereby, strictly speaking, steel is electrically refined rather than electrically made.

Future Metallurgy of Steel

And now a word as to the future: I am not unmindful that "a prophet is not without honor save in his own country." Moreover, human limitation and the kaleidoscopic changes of the past make one hesitate to forecast the metallurgy of steel. While ours is the age of steel, it has been given to men here present to see the passing of the age of iron. The crucible is hoary in its antiquity. The converter a short generation ago was but a conception in the mind of a man whom many of us know personally and the openhearth as an essential factor is even more striking in its adolescence. It behooves one, therefore, to be conservative in his prognostication. Forty years ago this country produced but little over a half million tons of steel, 90 per cent of which was made by the Bessemer process. Last year we made 43,000,000 tons of steel, and to the openhearth 75 per cent is to be accredited. While our production of Bessemer steel has remained nearly stationary since 1906, when it reached its zenith with an output of 12,250,000 tons, the openhearth has rapidly forged ahead, and last year it accomplished over 32,000,000 tons.

The marvelous development in Bessemer steel was due both to its superiority for general purposes as compared with wrought iron and to its relative cheapness of production. The more recent expansion of openhearth is attributable, not alone to changing ore conditions and to the lower cost incident to modern construction, but to the increasing demand for a higher quality of steel. The passing of the Bessemer plate and the Bessemer beam and channel was only a prelude to the replacement of the Bessemer rail by its openhearth rival. It is true that steel made by the Bessemer process is admirably adapted to certain products and for many years to come will play an important part in the metallurgical economies of our nation, but the glory

of the converter has definitely paled before the more enduring reliability of the openhearth. In the earlier stages of our steel manufacture, tonnage, as an essential element of cost, was a dominant consideration. Neither the mill nor the consumer attempted more than a general differentiation as to the character of the product. It was largely a matter of quantity and price. Now quality stands first and, while tonnage has gone on apace, volume has become more and more subordinate to character of production.

What does this increasing demand for higher quality portend for electric steel? How much is history to repeat itself in connection with the new process? It is clear that the lower the cost of production, the greater will be the field presented, and much will depend upon the ironmaster's ability to reduce the cost of electric refining to a minimum. When we realize the economies that have been commanded with the openhearth furnace during the last 20 years, it perhaps is not unreasonable to anticipate that much may be accomplished along similar lines with the electric furnace.

Future Increase in Production of Electric Steel

If one is intelligently to read the future, he must take into consideration both statistics and psychology. The annual statistical report of the American Iron and Steel Institute first separately classified electric steel in 1909, with a production of 13,762 tons. Last year this country produced 234,000 tons, which is more steel than was made annually in all our openhearth furnaces 30 years ago. The output of electric steel this year undoubtedly will be much greater. We are now producing at the South Chicago plant at the rate of 140,000 tons per year, and we shall shortly be producing at the rate of 200,000 tons per year. Our country is growing rapidly, and the per capita consumption of steel is growing even more rapidly. In 1900, our population was approximately 76,000,000, and each of our inhabitants represented an annual consumption of 280 lb. of steel. In 1916, our population had reached 103,000,000, and our annual consumption of steel had increased nearly three-fold, to 820 lb. per capita. These figures do not include our exports of nearly 5,250,000 tons made that year. So much for statistics.

As for psychology, we should not forget that the luxury of today is the necessity of tomorrow, and that emulation is a powerful creative force. Bessemer steel was eminently satisfactory until the superior quality of openhearth metal relegated it to a subordinate class. And now comes electric steel with a still higher standard. Safety cannot be measured by price and public opinion will more and more insistently call for the highest excellence in the automobile, the airplane and other forms of fabricated material.

Forty years ago Sir Williams Siemens dreamed of making electricity the handmaiden of the metallurgical art, and through his efforts his dream was realized in the birth of electrometallurgy. Twenty years later, Heroult visualized the dominance of electrometallurgy in the realm of steel. Whatever the future may have in store, let us remember that progress waits upon vision, and vision, even though it resolves for the moment into a mirage of shattered hope, often is ultimately translated into accomplishment.

Research Preparedness in the Zinc Industry

By Parker C. Choate

Action and reaction are equal but opposite. The early stimulation of spelter production by the war has caused over-production with a consequent drop in prices to the point where no material profit accrues to the distiller. This condition of affairs will soon be followed by sharp competition and the survival of the fittest, in other words, of those who possess the cheapest mineral values coupled with the cheapest method of extracting the maximum metal contents. Since zinc is perhaps the most prevalent of all metals except iron and aluminium in the minerals contained in ore bodies, the coming struggle involves the technical efficiency of the metallurgical process or the economical treatment of the complex ores of zinc rather than the procurement of the selected grades of concentrates.

In the following matter I will describe the general metallurgical present and future, as it appears to me, using broad lines of comparison, showing the commercial relations and the forces that will bring the radical changes for those who live by the zinc industry. Briefly, we must create the art of volatile concentration. We must briquet all retort charges, and proper briquetting involves pre-reduction and coking. We must adopt the vertical retort. We must make the gas as a costless by-product fuel. We must extract the lead, silver, and other valuable metals from the raw sulphide by leach electrolysis. This done, with the associated acts, we are led to a much cheaper operating cost, a better extraction, an easier labor problem, and an indifference to the relative metallurgical complexity of the zinc concentrate handled.

I do not aim to give details of operation, which however are largely at hand; on the other hand I will not picture any act or result that is not obvious through tests, by analogy, or by known metallurgical science. I can merely point the way in such a brief outline, but can submit details of practically all the statements, admitting that much is novel in either degree or principle.

It will be a great benefit if this radical picture brings out a full discussion. Such is needed for the well-being of the art, since no branch of metallurgy is in more need of advance.

Processes Now in Use

At present we are using retort distillation just as it was forty years ago. Acid manufacture was introduced as a necessity, while the volatile treatment of residues is unsound since they should have no value to extract.

The volatile practice is antiquated. Recently there have been several attempts to distill zinc in an electric furnace, none of which survive because of expense and inefficiency. However, there will probably appear a radically different process of electric smelting which will survive. It will be operated at the mines, without roasting the ore, and will save in one act over 90 per cent of the zinc, lead and silver as metals. The saving on freight charges and in expensive reduction plants is obvious.

Under the stimulation of war prices for chemically pure zinc a successful process of refining spelter by electrolysis has been established, analagous to the well known electrolytic refining of copper. This industry is

very creditable and perhaps profitable for a time, but its only future would appear to be in connection with the electric smelting described, which may produce a spelter carrying lead and silver as by-products.

We have also several examples of leach electrolysis using so-called insoluble anodes, the solutions being prepared by leaching roasted ore or a zinc-lead-silver fume. Leach electrolysis is with us to stay because up to a certain quantity the almost pure zinc will command the market. Furthermore, it is a very attractive process in the hands of mine owners who also have cheap water power and who now look upon the zinc content of the ore as a liability rather than as an asset.

In my opinion, the leaching of fume is the cheaper of the two methods when volatile concentration is efficiently practiced. In passing it might be mentioned that a true insoluble anode does not exist, and perhaps never will, due to the great destructive action of electric dissolution.

Volatile Concentration

Experiment shows that the art of volatile concentration gives a heat balance comparable to that of the usual boiler practice, the heat being conserved by a special design of flash boiler and hot-blast stove. The boiler and stove are to be made of prepared tubes which resist oxidation up to 800 or 1000 deg. C., and have entirely vertical surfaces automatically cleaned of dust. Since the blast is to be heated to a temperature above the ignition point of the fuel bed, it is obvious that no wet-tube water-circulating boiler can be used, because the boiling point of water is about one-half the ignition point of coal.

The fume is to be precipitated by electrostatic action from cooled gases. A mechanical bag-filter may finish cleaning the gases of the last fraction, as this work is difficult under electrostatic action.

Special stokers built on lines used in coal burning are to be used to charge the mix into the retorts. The admixed fuel may be reduced to 15 or 20 per cent of that now used, and if credited with the heat conserved in steam as power, may be under 10 per cent.

Zinc carbonates, silicates, residues, and low-grade raw sulphides may thus be heavily concentrated with high extraction of silver, lead and zinc at nominal labor and fuel costs. The conditions described above constitute a new art as compared to any existing practice.

Lead and Silver Extraction

I would propose to reverse the usual practice and extract over 90 per cent of the lead and silver values together with a large proportion of iron, if so desired, from the raw concentrates before decomposing the zinc blende, by a process of electrolyzed leaching. The solvent will be regenerated, and the power costs confined to the current necessary for deposition of the small weight of lead, silver, copper, etc., that is electrolyzed. This step may pass to the mine operator as an adjunct to flotation, rendering the most complex ores metallurgically as simple to the zinc smelter as the best Missouri blende. This process will perhaps be cheaper and doubtless much more efficient than the smelting of residues.

Sulphuric Acid

I see little value to the zinc distiller in making acid. When he realizes the trouble he avoids and the benefits he gains from distillation of raw sulphides the practice of acid making will cease. He may more profitably make the metalloid sulphur from the calcium sulphide residue, as it has ready sale and moderate freight charges to market. However, manufacture of acid may precede or follow distillation. It may be made from the sulphur extracted from the calcium sulphide residue or it may be omitted altogether with no sulphur smoke nuisance.

Briquetting

The briquetting of the entire retort-mix is a coming necessity, whatever the distilling practice. Good briquetting practice uses 6 per cent pitch as a binder, a compression of from 2000 to 5000 pounds per cubic inch, followed by coking at 400 deg. C. (or up to 800 deg. C. if cadmium and lighter impurities are to be removed). Caustic lime in the briquet requires special knowledge or hydration will take place during handling Properly made briquets cost about $1.00 per ton, including pitch and baking, are almost as hard as natural ore, conduct heat twice as well as the usual mix, and, if lime is used, reduce the zinc in residues to one per cent irrespective of the complexity of the ore, avoiding slagging action on the retort at the same time. Because of ideal contact reactions due to fine grinding and mixing, briquets use only about 25 per cent of the carbon in the usual mix. Their use also reduces the iron that usually passes to the spelter mechanically. Briquets should not be over ½ inch in cross section.

Fuel Gas and Carbon Mix

The best carbon for retort mix is the pulverous residue from low-temperature retorting of non-coking or lignite coals. This carbon is economically produced from local coal slack. Since it supplies valuable by-products of distillation such as tar and tar oils for flotation as well as a large excess of its own gas of distillation, that carbon used in the retort mix will be produced at no cost. As will be shown later, the entire fuel gas required for distillation of the zinc may also be a costless by-product of the manufacture of domestic briquets.

If we assume that it usually requires 125,000 cubic feet of natural gas to distill one ton of spelter, it may be assumed that recuperation of waste heat will reduce this to 75,000 cubic feet. If, now, we use the lime-briquet charge in the retort, it has been shown that one-half this fuel is saved by reducing the time and temperature of distillation. It is then practicable to use no more than 40,000 cubic feet of natural gas to produce one ton of spelter.

One ton of Illinois coal will produce 7500 cubic feet of excess gas, net, of about three-fourths the calorific power of natural gas, together with about 1500 pounds of carbon residue and a quantity of valuable by-products more than capable of paying for the cost of retorting. The briquetted residue will sell as domestic fuel for more than the cost of the coal and freight bills. The residue produced from low temperature distillation contains some undistilled hydrocarbons, makes the ideal retort mix, and briquets properly into an ideal domestic fuel in a section of country devoid of such.

If in a briqueted retort-mix with roasted or raw ore we use one to two pounds of carbon per pound of spelter produced, we may calculate: For one ton of spelter we must manufacture 50,000 cubic feet of gas of 600 to 700 B.t.u., from about 6 or 7 tons of slack coal, producing

at the same time 3.75 to 4.5 tons of carbon residue with the usual tarry by-products. We use in our mix up to two tons of carbon per ton of spelter produced, and consequently sell 2.5 to 3 tons of briquets and other by-products at a material profit.

Retort Furnaces and Distillation Practice

The labor problem in present distillation practice is serious and expensive. It is obvious that the use of vertical retorts will cut labor bills heavily and reduce the amount of specialized labor necessary. It will further reduce retort costs, since more enduring retorts can be made up to 20 inches in diameter. A dead-core retort can be provided giving a larger ratio of volume to circumference with no greater depth of heat penetration than in the present practice. Vertical retorting can also be made continuous, as has already been done.

I believe that the briquet made with raw ore and burned lime is the charge of the future. The virtues of this mix will gradually be appreciated by operators after actual practice. Should the distiller desire to continue roasting, he may do so and hold his residues down to one per cent of zinc, irrespective of the degree of roast, by using under ten per cent of lime. However, the raw-ore briquet is the better heat conductor, acts better in the retort, and requires the lower temperature for the reaction. If there is any real value in the sulphur content of the ore it would seem best to reclaim it from the calcium sulphide residue.

The firing of retorts should be by small gas jets. Pulverized coal will be found a most efficient auxiliary and can be introduced through the same jet system. I can see no future for the large single-flame burner. Pulverized coal firing is well established, offers large savings and economies over producer practice, and produces heats much better under control. It is practiced best with the dead coals or carbon residues and involves the same principles of draft and pressure as gas firing, while the fine ash produced by powdered coal is understood and handled better than the slags formed in producer-gas firing. In special locations the combined use of retort gas and pulverized carbon may be the most economical, but not where a civic population can consume a domestic briquet in quantity.

Recuperation of waste heat can now be performed in specially prepared iron pipes which easily withstand oxidation up to 800 to 1000 deg. C., and even more for a limited time. This item materially affects plans for conservation of heat.

Quality of Spelter

If we remove lead by leaching concentrates, none will enter the spelter. The same may be said of the iron; but in this case, the lime briquet permits only small quantities of iron to pass over into the spelter mechanically, the amount not increasing even in the third draw of metal, even with concentrates up to 10 per cent of iron.

Cadmium, together with other lighter impurities, may be largely removed in coking the briquet, simply by raising the temperature to about 800 deg. Centigrade.

Economic Forces

Past practice will be abandoned for that which will produce a cheaper metal, owing to the over-stimulation in production and the existence of other methods than zinc distillation, but more especially to the demands of labor and the increased cost of coal. Thus the forces of necessity will soon make technical efficiency the dominating factor among zinc distillers. It will no doubt be difficult to abandon large investments in furnace equipment, and many directorates will be incapable of seeing the necessity of so doing, but those who do not will be forced to give way to those who do. The economic forces must rule. Conservation is the root of economy, and the dominant factors in this instance are fuel and labor.

Conclusions and Comments

In reviewing the subject, perhaps I see the more merit in the fume-leach-electrolysis idea because I invented and practiced it twenty-five years ago; but today I see the chances for improvements in volatile concentration and the possibilities in the use of a composition anode.

I am satisfied that the small electric smelter will find a place in the hands of the mine operator, there being by-products in metals to save and freights to reduce. The removal of lead and silver prior to distillation will materially enhance the value of the complex zinc ores to the mine operators.

The greater changes are necessary in distillation practice, and their economies are obvious. They must offset the heavy freight bills by materially raising the extraction and by the conservation of heat and labor. Research shows that briqueting will solve the domestic fuel question for the Middle West, since the distillers have a use for the gas, while the domestic consumer will be provided with a fuel fully equal to anthracite at a lower cost.

There would appear to be no larger public service of lasting kind than the double act of giving the West an ideal economical fuel made from their local non-coking coals and lignites, and placing the zinc distillers on a firm basis to meet the impending competition with leach electrolysis and electric retorting processes.

Today the Western public largely loses the volatiles of their local coals in their commodity use, with the simultaneous production of a smoke nuisance. If the local coals are carbonized and briqueted as is already practiced in a small way, there is difficulty in selling the excess gas produced. The zinc distiller must use gas, but if he uses producer gas, he does so only at a great sacrifice, since it has a low calorific intensity and no by-products are saved. The economies accruing with low-temperature carbonization aggregate large figures.

Definite experimentation will be along radical departures, but for that matter, so was the flotation process. A working unit of industrial size alone can show the economies. "Seeing is believing" to the business mind, no matter how clearly the engineer makes his figures and deductions.

Following the lines of conservation, why would it not be good business for several large interests to join in this radical research? In this manner the inevitable duplication and the patent war could be avoided. The zinc distillers centered in a thickly settled community in the Middle West can do the community a large service at a profit to themselves under the research outlined above.

Essex, Mass.

The Rubber Embargo

Economic Effects of Reduced Rubber Supply—Reclaiming Old Stock—Guayule as a Local Source of Natural Substitute

BY ANDREW H. KING

SOMETHING over a year ago the writer published a series of three papers dealing with the crude rubber situation, and pointed out as a matter of national preparedness that our country should be, at least in some measure, independent of foreign sources of supply. The incentive which led to these papers was the spectacle of a modern nation suddenly deprived of its supply of crude rubber. We know absolutely that the blockade has touched a very vital spot in the German armor. If kept tight enough and the war lasts sufficiently long, the absence of rubber may ultimately become one of the straws which will break the camel's back. One very pertinent instance may be cited. The Allies now have one of the most elaborate systems of gas defense that can be devised. Every man and every animal liable to gas attack has his gas mask. These masks are quite effective and give absolute protection against all of the gases as yet used by the Huns. They consist primarily of rubberized fabric. The Germans have no rubber so make their masks out of leather. As a consequence they are stiff, hard to put on, and do not fit well. Allied gas attacks are in many instances successful because of the length of time required to adjust the enemy mask.

TRANSFER OF SHIPPING CURTAILS CRUDE SUPPLIES

Little did the writer, or any one else for that matter, imagine that there was any immediate danger of even a curtailment of our crude rubber supply. We thought it something worth thinking about for the future, but no one dreamed that such a situation would develop so quickly. The possibility of a hostile fleet blockading our shores was then, and is still, remote; but the contingency which very few if any of us realized was the great efforts which we were to make on entering the war. Those who are in a position to know say that the greatest trouble has been to make the American people realize what an enormous responsibility rests upon them. The war on barbarism is not to be a side issue nor any sort of a picnic. We are in this thing and for the sake of posterity we must not lose. Our effort must be that of a whole united people. The ultimate decision rests largely upon the American public. We hold the balance of power. If we get into the harness as efficiently and as completely as the French and British, there can be no question of the outcome. There is every evidence that we will equal if not exceed our allied friends in this business of war. The progress which has been made in the first year has been really remarkable. There has been very little grandstand playing and hip-hurrahing, but the wheels have been made and fitted together. Now they are beginning to turn. While all that has been done is due primarily to the spirit of the people, yet no small credit must be given those who by helpful criticism sought to correct evils and mistakes of management.

The present situation on the Western front is an extremely critical one. Germany has already tried out the mettle of American soldiers and has found it better than her most pessimistic observers ever had the nerve to admit. She is well aware of the great organization now getting into low gear and she knows perfectly well that such a steam roller will finish her dreams of world conquest when it gets properly working. Her only hope for victory is to defeat the French and British before our strength becomes a deciding factor. This is the reason for the spring offensive. If Hindenburg can break the allied armies within the next six months regardless of what it costs him in lives or in money, Germany will win. Such a calamity is not impossible. In fact, the chances are almost fifty-fifty now. Our brave allies must bear for just a little longer the combined might of the German war machine. So it becomes imperative that American soldiers be sent to France just as fast as sufficient ships can be furnished for their transportation and to keep them supplied. The slogan "Ships will win the war" is absolutely true. The submarine warfare of the enemy, while not successful, has made a great dent in the world's shipping. Because of this emergency ships are being withdrawn from all possible peaceful pursuits, and we are brought face to face with a new paradox, a blockade of ourselves by ourselves in the interest of national safety and world progress. There are not yet sufficient ships to handle normal commerce and to transport the troops with their supplies. When our shipbuilding program gets under way this condition ought to be considerably bettered, but for the time being peaceful trade must suffer.

The situation is, of course, not nearly as serious as an enemy blockade but the curtailment of raw material will be keenly felt not only in the rubber industry but others as well. In the matter of shipping, rubber is rather a serious offender since such a large space is required to carry comparatively a small weight, and the distances to be traversed are so enormous. The specific gravity of rubber is about .93. Its weight per cubic foot is 58.1 lb. So to transport a ton (2000 lb.) of rubber the very least space required would be 34.4 cu.ft. As a matter of fact the actual space necessary is about 20% greater, making it about 41 cu.ft. America imported last year about 157,000 tons of rubber. The cargo space occupied was approximately 6,500,000 cu.ft.

SOURCES OF OUR RUBBER

Much of our rubber comes from the far East. In 1916 only 23% of the 116,477 tons consumed was imported from South or Central America. Most of the 77% remaining (very little comes from Africa now) was plantation rubber from the Far East. The distances are tremendous. Singapore, which is located on the tip of the Malay Peninsula, Federated Malay States, is probably the most important marketing place for crude rubber in the world. The old route now closed because of submarine activity in the Mediterranean was by way of the Red Sea, Suez Canal, Mediterranean, London, and thence to New York. The distance is 12,-900 miles. This made London the neck through which nearly all the crude rubber in the East had to pass. The new route is by way of Honk Kong, Yokohama, Honolulu, to San Francisco or Seattle, and thence by

rail to Akron or New York. Singapore is 8460 miles from San Francisco, which is approximately 3000 miles by rail from New York, making a total of 11,460 miles. An all water journey from Singapore to New York by way of the Panama Canal is 11,760 miles long. By way of comparison, the port of Para in Brazil is 2600 miles from New York. During the past two years a constantly increasing tonnage has been shipped direct from the far East to our Pacific ports. It requires no stretch of the imagination to see that a great deal of shipping is required to supply us with crude rubber. Any curtailment in this supply will set free a respectable number of first-class freighters which are badly needed for the troops.

This is exactly what the Federal War Trade Board wishes to do. There is no desire to work undue hardship to the industry and as a consequence the first plan proposed, which will be in operation before this is published, is to be effective for only three months, after which the working will be reviewed and such modifications as are necessary will be made. The plan is as follows:

During 1918 there are to be only 100,000 tons of crude rubber imported, which figure is 57,000 tons less than the official estimate for 1917. The 100,000 tons includes a quantity of 35,000 tons which the government reserves for strictly war purposes. This rubber will be used in gas masks, balloons, truck tires, auto tires, proofing, etc., and the figure is none too high. This leaves only 65,000 tons to take care of normal peace time activity. The official figures for net consumption for the past five years are as follows:

1913... 49,850 tons
1914... 61,251 tons
1915... 96,794 tons
1916... 116,477 tons
1917... 157,000 tons (About 170,000 tons imported)

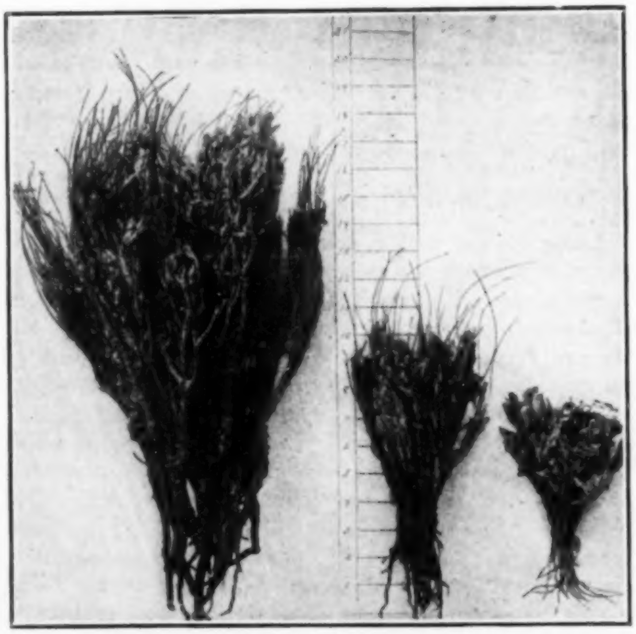
During 1918 there will doubtless be quite a decrease in demand for rubber goods for civilian purposes, but even on the basis of 1916, which will probably be about right, our rubber factories will face a shortage of 51,500 tons. In other words, the supply of crude rubber for ordinary purposes is to be cut in half.

Rubber on hand or in transit is not affected. The large companies have on hand from four to six months' supply. A department with which manufacturers may deal directly in importing rubber has been established by the Trade Board in Washington for the period of the war. Crude rubber can only be imported by obtaining licenses from this department and guaranteeing that the amount purchased is within the restricted quantity fixed by the government. Prices have already been fixed, varying from 62 to 68 cents per pound, depending on the grade of rubber imported. Prices on manufactured articles have not yet been fixed but probably will be if there is any tendency towards inflation.

In certain quarters there is a disposition to meet the new turn of affairs with an optimistic feeling that three months will see the end of the embargo, that after this time ships can again be spared and that the government will see the fallacy of throwing thousands of men and women out of work, etc. Such an attitude shows a woeful lack of foresight. Within three months the large companies will doubtless be swung over to meet the new conditions. No one gauged corectly the huge effort that America would make in the war. The first plans were for an army of 2,000,000 men. Now it is proposed to put an army of 10,000,000 men in France. The demand for shipping will increase rather than decrease and the present curtailment will likely prove to be only the first pinch. Within three months we may be asked to take a further 50% reduction, and it is not impossible that within a year we may be importing only enough rubber for war needs. This does not by any means sound the death knell of the American rubber industry. The men directing it are big enough and resourceful enough to weather through. The fate of the small companies, poorly financed and without extensive organizations, is more doubtful. There may even be several failures.

Our Industries are Our Effective Resources

There is another angle to the situation which may well be given a brief mention here. On all sides we hear slogans—that food, ships, etc. will win the war. All these are merely incidentals. There are but two fundamental necessities—Spirit and Money. The first we have in large measure and need not be further discussed. The second we have also, but its application is a little different. The huge and heretofore unheard of sums of money spent every day by the opposing armies are understood by all as well as our powers of imagination permit. Such a stream of gold is required to feed the war machines that it would be well to look at the source. All money is the fruit of business and the product of industry. We must keep the source of money in good condition.



THREE YEAR, TWO YEAR, ONE YEAR
Crowth of Guayule or Grand Cut-Over

There are two ways of paying for the war: One is to tighten the belt a few notches and take it out of savings. This excellent idea is embodied in thrift stamps and in the bank plan for Liberty bonds. The other is to make the money by extensive trading with

neutral countries, selling them more than they sell us. This last is all very well provided there are any neutrals and they have the money to purchase with. Our greatest markets are now South America and perhaps China, in both of which extensive selling campaigns should be carried on and for which efforts to give passable steamboat connections should be made. Manufacturing for home consumption will be limited more and more to those things which are essential and non-essentials will go by the board. But for export to neutrals we should make everything there is any demand for, whether it is essential or non-essential.

About 70% of the crude rubber imported goes into automobile tires. The tire is part and parcel to the automobile whose only purpose is transportation. The machine can no longer be looked upon solely as a pleasure car, i.e., a non-essential. By far the larger portion of American automobiles are real necessities. They are the best antidote for the tendency of modern men and women to crowd into large cities and bring about undue congestion. They are now as firmly woven into our national life as the horse was 30 years ago. Auto tires are essentials and should be considered as such. Consequently their manufacture for certain purposes should not be reduced to the point where it will work a hardship to the car owner. The service of truck tires needs no comment. They are just as important to the army behind the line as to the soldiers in the field.

The position of the rubber manufacturer is unique. For patriotic reasons he must import as small a quantity of crude rubber as possible and for other equally patriotic reasons he must keep his countrymen supplied with all rubber products which are essential. But what may he use in place of crude rubber? Synthetic rubber is not a commercial possibility. With the advances which have been made in rubber tree cultivation such an industry is now impractical. There are only two solutions, both of which are required. They are shoddy and guayule.

Shoddy

By shoddy we mean reclaimed rubber. The methods of reclaiming were discussed by the writer in a previous paper (this *Jour.*, Mar. 15, 1916, p. 310). The most satisfactory and most generally applied process is that of A. H. Marks, U. S. 635,141 Oct 17, 1899, which has now expired. This procedure consists essentially of digesting finely ground waste in a 3% sodium hydroxide solution at 125 lb. of steam (344° F.), with stirring for 24 hrs. more or less as required.

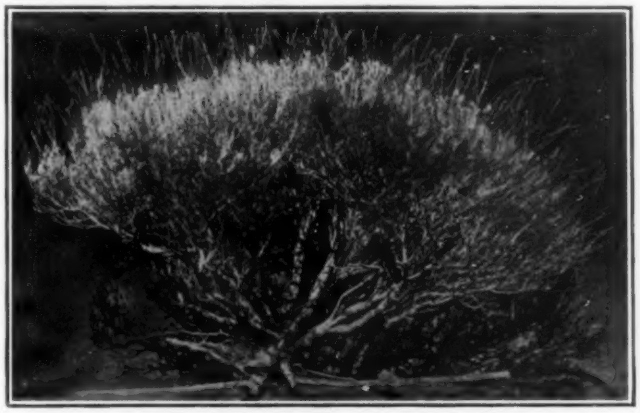
Many factories have their own reclaiming plants and there are numerous firms which make it their sole business. The machinery for extensive production of shoddy is at hand and will doubtless be used to the limit of capacity. A better organization among the scrap dealers would be desirable as would be a better co-operation between the consumers of rubber goods and the scrap gatherers. The public should be instructed as to the importance of the smallest piece of scrap rubber, and all worn out articles should find their way to the reclaiming plants.

But the reclaiming plants cannot produce a shoddy the equal of crude rubber. Germany has had to depend upon them alone and we know how she has failed. The quality of her rubber goods has declined to the vanishing point. The function of reclaimed rubber is merely to stretch the crude rubber supply and not to replace it entirely.

Guayule

The real load will utimately fall on guayule, which can be imported from Mexico by rail. During the past six years the harvesting of guayule has been greatly retarded by the unsettled condition of Mexico's internal affairs. Happily things now seem to be improving. Some one has evidently spoken a soft word to Carranza and the German agents appear to have cast Villa adrift. Mexican guayule is now being placed on the market by at least two large corporations.

In the years before the revolution Mexico annually produced about 10,000 tons of guayule. The decline began in 1911, by 1912 it was only 3500 tons, in 1914 but 728 tons. 1915 saw an increase, the production



GUAYULE SHRUB.

amounting to 2555 tons. For the twelve months ending June, 1916, was 1408 tons.

In the above I have stated that the action of the War Trade Board has created a shortage of over 50,000 tons of rubber. The all important question now is—can this deficit be made up with guayule? Endlich estimated that up to 1909, 225,000 tons of shrub had been harvested, which was about half the supply originally available. By best methods of treatment the shrub yields 9.5% rubber, based on the dried weight. If Endlich's estimate were true there must have been only 22,500 tons of rubber available in 1909. But Mexico has exported since then something like 30,000 tons of guayule, so it must be concluded that he was entirely too conservative. To estimate with any degree of accuracy the shrub content of such a large area is almost impossible owing to the irregular nature of the separate groups.

Since 1912 there has been but very little harvesting in the great Chihuahuan district. Since 1910 more care had been taken in gathering the plants. They were not ripped out root and all as in the old days, but were neatly cut off at the ground. This left the root system intact, so that it would send up shoots which could branch out and produce a bush at least 16 inches high in five years. Fifteen years is required for guayule to grow from seed to maturity in the desert. There ought to be great quantities of new

plants available, to say nothing of those which must have grown from the roots of plants previously cut. It is now six years since the Mexican trouble started. A very safe estimate of the shrub now available may be placed at 500,000 tons, which when harvested should yield about 50,000 tons of rubber.

This takes no account of the rubber produced by our own Southwest. In 1911 there were 6,000,000 acres of guayule growing wild in Texas which is in the same belt as the great Chihuahuan desert. There is also the factor of cultivated guayule which will soon be of considerable importance. The International Rubber Company now has rather a large plantation near Pacheco, Arizona. This is being gradually increased. It is said that the present extent is near 10,000 acres. This company is said to be backed by the Standard Oil Company, and has a capitalization of $29,000,000. It still controls a number of large plantations in Mexico.

Production Increased by Intensive Irrigation Methods

DeKalb claims that in California guayule under irrigation has been known to produce as much as 28% of its net dry weight in rubber. He also states that by four year intensive irrigation methods 25 tons of the dry plant may be grown per acre. The best scheme is to irrigate with plenty of water until the plants become sufficiently large and sturdy. The water is then shut off for six or eight months, during which the plant produces rubber in the tissues. At the end of this time irrigation is resumed and is continued till a new growth takes place, after which the water is once more shut off. This procedure is repeated until four years have expired, when the plant is ready for harvest.

The proposition of guayule plantations is one which has been neglected long enough. It is time for American business to get behind it and to push it along. Such an industry would be a financial success, paying it is conservatively estimated 8% without irrigation, or $180 per acre per year on irrigated land.

Obstacles in Way of Use

To swing over completely to guayule from plantation rubber would now be quite a hard task since it has been out of the field so long. There are now not many of the old compounders left who handled it in the days when it made up about half the crude rubber used in the country. Employed alone without treatment it is not satisfactory for high grade stocks. However, it can be blended with plantation rubber (Hevea) with reasonably good results. If one is to get the value out of guayule it must be deresinated. It contains approximately 25% resin, which behaves somewhat like so much oil and has a dissolving and softening action on the rubber. This comes into play during vulcanization and later when the article is in service. The extracted resin may be disposed of by milling it with dry shoddies, on which it has rather a beneficial effect.

There were in this country at one time about fifty deresinating plants, nearly all of which have now been dismantled or turned to some other purpose. Before the country can again make use of guayule to the best advantage new plants must be built and perhaps new procedure adopted.

Plans for Preferential Fuel Distribution

Plans for the distribution of coal within the various states have been formulated and put into operation by the United States Fuel Administration. This plan is designed to define the responsibility and authority vested in the State Fuel Administrators for the distribution of the coal alloted to their respective states, subject to general instructions issued from time to time from Washington.

The War Industries Board will decide what consumers shall have preference in securing coal; but the United States Fuel Administration has been asked to assist in the compilation of complete preference lists of obtaining reports and recommendations on individual firms from the State and Local Fuel Administrators.

The crux of the new distribution plan lies in the compilation of these preference lists. All consumers of coal, except domestic consumers, will be recorded under the following classifications:

(a) Railroads,

(b) Army and Navy, together with other Departments of the Federal Government.

(c) State and County Departments and Institutions,

(d) Public utilities,

(e) Retail dealers,

(f) Manufacturing plants on War Industries Board's preference list,

(g) Manufacturing plants not on War Industries Board's preference list.

The first six classes will be given preference in coal shipments in co-operation with the plants of the War Industries Board.

The distribution of coal to consumers in the first two classes will be handled from Washington. Washington will also supervise shipments to a few vitally important plants.

The list of consumers entitled to preference as established by the War Industries Board will be obtained through a questionnaire sent to every manufacturing plant in the country using more than 500 tons of coal annually. This list, when compiled, will be furnished to each Fuel Administration District Representative in the producing fields which supply the various states; and with these lists to guide them, together with weekly reports which will be required from each manufacturing plant, the State and Local Fuel Administrators and District Representatives will give their particular attention to building up proper stocks of coal at all essential war plants.

In order to control the distribution of coal to domestic consumers and industrial plants by retail dealers, the dealers will be required to make a special report to the State Fuel Administrators and from these reports deliveries to manufacturing plants not on preference list can be curtailed when necessary.

Under this plan of distribution each consumer should arrange for shipments from the same source of supply as last year, if possible. If diversion of coal for the war program, or the zoning system will not permit this, the consumer should make every effort to form new connections, preferably under a contract arrangement, wherever a supply is available, before calling on the State Fuel Administration.

Prospects of a Chemical Industry in Southern California*

The Possibilities of the Development of the Deposits of Lignite and Desert Alkali into Sources for the Production of the Fundamental Chemicals

BY JULIUS KOEBIG

IN DISCUSSING the prospects of a chemical industry, it is essential to define the scope of the term. We have many smaller and larger plants on the Coast which we call chemical factories and of which we are accustomed to boast at home and abroad, but we have only a few whose name and importance are more than of local interest. The principal exceptions are in the manufacture of sulphuric acid, super-phosphates, explosives, soap, Portland cement, beet sugar, leather, and the refining of crude oil. They are in a flourishing condition wherever they are not unduly capitalized, and where the management expects to earn its profits from the earnings of the plant rather than from the manipulation of the capital stock. The basis of their success is:

(1) Abundance of suitable raw material at a cost comparing favorably with the cost of raw material in competing centers of the respective industries.

(2) Adequate local facilities for manufacturing and transportation.

(3) Home market for the product and opportunity to extend the market within a reasonable radius.

(4) Last, but not least, skillful management capable of modifying manufacturing methods according to local conditions and of improving constantly on such methods, both with regard to cost and quality of product.

Every one of the established plants, be they small or large, together with almost every industrial enterprise on the Coast, is at present under the disadvantage of the high cost of heavy chemicals. Many others are out of the question, because of this high cost of heavy chemicals. Without a home production of heavy chemicals, at prices not much higher than they can be produced in other centers of industrial activity, it is useless to expect the development of a chemical industry. This, however, demands large capital, enterprise and efficiency.

It is my purpose to place before you the possibilities in Southern California which justify the investment.

The vast chemical industries in Germany, France and England started from the manufacture of cheap soda, and still base their success on this product.

The manufacture of cheap soda is the very life blood of the rapidly increasing chemical industries of the East. Unless we are able to produce cheap soda, it is useless to try and build up a chemical industry.

Before closing these introductory remarks, permit me to give you some of my own personal experiences. When I was Assistant Professor of Chemistry at Strassburg, a gentleman called on me and asked if I would enter his employ for the purpose of developing an aniline dyeworks. I told him that I had no experience in the manufacture of dyes. He replied that he wanted a chemist, the practical part would subsequently take care of itself. When I resigned, after three years, we had over three hundred men in our employ; we had some fourteen chemists directing the work in the factory; I had a research laboratory in which from ten to twelve chemists were constantly at work on the development of new products and processes; and the factory paid from 80 to 250 per cent dividends each year.

On a trip across the Atlantic, I made the acquaintance of a gentleman heavily interested in an illuminating gas works in one of our largest cities. In discussing the possibility of utilizing his coal tar to better advantage than selling it at low prices for export, I advised him that the first step must necessarily be the erection of a tar refinery. He sent an engineer to England to copy the equipment of a prosperous tar refinery there. He bought, at high cost, the recipes used there, and hired a foreman in their service. He employed a chemist, not for running the factory, but for finding out whether there were differences in the guaranteed strength of acids, etc., which he bought. The refinery never was a success. After a few months an explosion occurred and the plant burned up. The typical differences between these two views is that of success and failure.

THE NECESSITY OF INORGANIC INTERMEDIATES

The fundamental requirements for a successful development of a chemical industry are:

Cheap acids,
Cheap soda,
Cheap fuel and
Cheap power,

to which has to be added cheap iron for machinery and apparatus.

Without these, and all of these, chemical works are doomed to remain of secondary importance. All they can hope to accomplish is the refining of half-finished products. The life of such industries, no matter how profitable they may be from the start, can only be a limited one. It is only a question of time before the consumer will learn to use the half finished product or to do his own refining, thereby cutting out the refiner's profit. One example will suffice to illustrate this fact. Establishments in this state, which carried the proud name of soda manufacturers, bought soda-ash and caustic soda in Europe or later on in the East. They produced sal soda and lye in small packages for the use of soap manufacturers and others, in addition to supplying the household trade. Some of these factories grew to considerable proportions. But today they are reduced to the level of retailers, while the consumers buy their supplies directly from the real manufacturers of soda.

These refiners, however, served a well-defined economical want in the early days of the development of our State. At that time the market for any kind of com-

*Read before the Los Angeles Section of the American Chemical Society.

modity was small. We had few consumers of chemicals, or any other kind of merchandise for that matter, whose wants justified the purchase of needed supplies in lots sufficiently large to obtain reasonable freight rates. We then were tagged away in splendid isolation in the remotest corner of civilization. Our sturdy pioneers thought little of the cost of living and had less demand for manufactured articles. They had to and did employ their spendid energy and every available dollar at their command for the purpose of turning our state from almost half savagery into a fit place for human habitation and the pursuit of happiness. How well they have succeeded, we all know. In addition our railroads and the Panama Canal have changed our location from an isolated spot to almost the center of the coming commercial development, which is bound to have the countries bordering the Pacific as a stage. This shifting of the commercial situation, our large and rapidly increasing population, the development of our mines and agriculture, all make insistent demands for our industrial chemical development. Our mines need heavy chemicals for the reduction of their ores. Our fields and orchards need fertilizers for assuring their continued fertility. Our agricultural industries need chemicals again for manufacturing our agricultural products into staple articles. Our animal industry, our tanneries, our soap makers are handicapped on account of the high prices of chemicals. Our oil refiners offer a large market for soda products. These and many other industries already established offer an alluring market for the products of a general chemical industry, so that there can be no possible question of a market. This alone, however, is not sufficient. We must have the raw materials and manufacturing facilities required to secure a profitable production which will put us on a square, even footing with the centers of industrial activity now furnishing the products needed, so that we can rely upon our ability to retain our home markets for our home products against the keenest competition. It is my endeavor to show in how far our available raw materials justify us to advocate a general chemical industry under the local conditions.

In the manufacture of sulphuric acid we have already made a long step forward. Both the lead chamber and the contact processes are in successful operation on an even footing with other states and countries. Sulphur and pyrites are readily obtainable here. Our metallurgical works furnish us a never-ending supply of sulphur dioxide from their roasting furnaces, which is now mostly used in the production of by-product sulphuric acid. In conjunction with this sulphuric acid, muriatic and nitric acids could be manufactured; the former from our large salt deposits, and the latter from Chilian nitre, which is as economically obtainable here as in the East; however, we would be under great disadvantages at present, because our market for salt cake is very limited.

The Soda Industry

In the alkali industry, conditions are decidedly different. At present, we have none. In order to ascertain whether such an industry is possible in Southern California, I must ask you to follow me in a short review of its history and its present status.

Perhaps the most epoch-making progress in the chemical industry during the last 150 years was the Leblanc soda process. In England, where it found its first home and received its most essential development, it reduced the price of soda-crystals from $300 per ton in 1814 to $13 per ton in 1896. Its principle is a very simple one. In its first phase common salt is decomposed by the aid of sulphuric acid into sulphate of soda, commonly called salt-cake and hydrochloric acid. In its second phase the salt-cake is treated in the black-ash furnace with limestone and coal. The resulting black-ash consists essentially of sodium carbonate and insoluble calcium mono-sulphide. By leaching the soda is brought into solution. The remaining calcium sulphide forms the alkali maker's waste. As long as the factories were few and of small capacity, the muriatic acid was allowed to escape and the waste, a bad malodorous nuisance, was dumped into the ocean. But soon it became necessary to recover the muriatic acid and also to find some way of utilizing the waste. The one was accomplished largely by the manufacture of bleaching powder, the other by the ingenious chance process which recovers the sulphur and lime from the waste.

The second method for the manufacture of soda-ash is the Solvay ammonia-soda process. Its raw materials are salt-brine, ammonia and limestone. A properly proportioned mixture of salt-brine and ammonia is made which is treated with carbon dioxide. The bicarbonate of soda separates as crystals and is filtered dry. The filtrate contains ammonium chloride from which the ammonia is recovered by distillation of the limed mother liquid.

The third is the electrolytic process, in which the salt brine is decomposed by the electric current and chlorine gas and caustic soda produced.

Many other methods have been proposed. They, however, have either proven to be impractical or only of secondary importance like the manufacture of soda from cryolite.

The Leblanc process today has been almost entirely abandoned in favor of the ammonia process. The enormous factories in England and on the European continent have either gone out of existence or changed to the cheaper Solvay method. The reasons for such change are obvious. In the first place, it is necessary for the economical handling of the Leblanc process to combine under one roof the manufacture of sulphuric acid, sulphate of soda and the final black-ash, which requires an enormous outlay for first installation as compared with the Solvay or electrolytic processes. Then again it is much cheaper to produce and handle the large tonnage of salt in the form of brine than it can possibly be in the form of dry salt. And last but not least, the vast amount of muriatic acid, requiring heavy, expensive and costly apparatus for its recovery, does not find a ready and profitable market, either as acid or in the form of bleach.

Source of Soda From the Desert Alkali

In considering the development of the alkali industry in California, we have therefore apparently only a choice between the Solvay and the electrolytic processes. Unfortunately neither of them is adapted to our present conditions. Except in the condensed sea water, we have no sources of the brine required as the starting point. Even the sea salt works, using solar evaporation, can-

not begin to furnish brine of proper concentration at anything like the cost of the brine produced from the salt beds of New York, Michigan and other states. To dissolve the salt from our desert deposits is far too expensive. Our gas works use oil for the production of illuminating gas and therefore cannot supply a prospective Solvay soda works with the necessary large supply of cheap ammonia. The cost of electricity from our hydro-electric installations is much too high for the use in the electrolytic process. Finally, we have no adequate market for the large quantity of calcium chloride of the Solvay process nor for the chlorine of the electrolytic process. This leaves us in the deplorable condition of having to develop some new and untried method, if we wish to start the very foundation of a general chemical industry. But fortunately, nature itself holds out the solution of the problem, characteristic only to our arid regions, in our desert alkalies. We have some deposits of very great magnitude which consist of sulphate of soda of as great or greater purity than the best salt-cake manufactured in the first phase of the Leblanc process. It is possible to mine and ship this sulphate to a convenient factory site at a cost considerably less than $5 per ton. By using this natural salt-cake in the second phase of the Leblanc process, we do not only find a manufacturing method in the perfection of which, in all its details, hundreds of the best chemical engineers have worked for nearly a century, but we also omit all the unfavorable features, which resulted in its decline in competition with the Solvay process. The required capital for its installation is reduced to one-half or one-third by the omission of the costly apparatus for the manufacture of sulphuric acid and the conversion of salt into salt-cake in the first phase of the process. The great disadvantage of producing the enormous quantities of muriatic acid, for which we have no market, is entirely done away with. The only by-products are sulphur and carbonate of lime, of which the latter goes back to the black-ash furnace. Since nature has done, for our arid regions, the most costly part by offering the natural salt-cake as a raw product, it has given us an opportunity to revive the Leblanc process in a manner possible only and eminently characteristic in this part of the United States.

A careful calculation of the cost of production of soda-ash, using oil or producer gas as fuel, and taking $5 per ton as the value of salt-cake delivered at the factory, results in a cost price of not to exceed $10 per ton or 96 per cent soda-ash. It is hardly possible to over-estimate the immediate influence which the reduction of the cost of soda-ash to one-half of its present price will have in stimulating our already existing industries. Since it would at once put us on an even footing with the cehters of the chemical industry in this country and abroad, it would enable us to manufacture our own cyanide for mines and orchards as well as permit the home production of a large line of fine chemicals. Last but not least, we could in time not only supply our home markets, but enter the export trade with a certainty of being able to hold our own against the keenest competition.

In close relation to the alkali industry stands the manufacture of potash salts. The prospects of its development on the Coast are certainly bright ones. The problems involved in the extraction of potash from kelp, alunite and some favored desert deposits are at present under serious consideration. I have no doubt that they will be favorably solved in due time. The necessity, however, of utilizing all by-products, for a permanent commercial success, imperatively points to the establishment of a general chemical industry to take care of them. I am inclined to believe that both are so vitally dependent upon each other as to venture the assertion that together they are bound to succeed, while singly, the potash industry may fall far short of the sanguine expectations.

In considering the fuel situation, we are in the fortunate position of being able to meet all demands with a considerable margin in our favor. Our fuel oils furnish an excellent and economical fuel for all manufacturing purposes. It is only to be regretted that some of our best oilfields have passed into the control of other than American interests. The devolopment of the refining industry is gaining larger proportions every year, which necessarily means increasing market for chemicals. One of the principal demands will be for cheaper soda products. In the refining of our crude oils, there are many phases of utilizing all possible by-products, which will have to await a general chemical industry for their ultimate commercial success.

Lignites as a Source of Gas, Tar and Ammonia

In the lignites, of which a few large deposits exist in our state, another source of fuel is available. It is a matter of general knowledge that this coal cannot compete with the cheaper and more economical crude oil as a fuel for manufacturing purposes. The value of our lignites, however, are very large indeed, if we consider them in the light of a raw material for a chemical manufacturing industry. With the aid of producer furnaces and gas engines, our lignites are able to produce electric power even at a less cost than the average of our hydro-electric plants. In the by-product producer furnace, the lignites will give us an important source of ammonia and coal tar besides the electric power. The by-product coke oven adds to these a very serviceable coke for many purposes. The results obtained by me in an elaborate research on this subject are eminently satisfactory. I cannot forego the opportunity of stating a few of them.

Cost of electricity produced from lignite at the pit mouth with producer furnace and large unit gas engines.

ELECTRIC POWER PRODUCED FROM LIGNITE

Cost of installation per kw	$100.00
Cost of production per kw.-hr., including 16% fixed charges on capital.	.43

PRODUCTS FROM 1 TON LIGNITE IF USED IN BY-PRODUCT

Coke Oven

872 hp.-hr., valued at ½ cent	$4.36
60 gallons of tar valued at 3 cents	1.80
70 lb. ammonium sulphate valued at 3½ cents	2.45
800 lb. of coke valued at $2.50 per ton	1.00
Total	$9.61

If you consider that the value of lignite at the pit mouth does not exceed $1 per ton and that the total cost of operating such a plant is not more than $2 per ton, these figures need no further explanation.

The coke obtained from our lignites certainly is not of a quality adapted to the operation of blast furnaces. But my as yet incomplete research work has resulted in showing a way, by which I feel positive first-class blast furnace coke can be manufactured from at least

some of our lignite deposits. This coke, however, is an ideal raw material for the manufacture of calcium carbide and calcium cyanimide. In the production of this coke not only sufficient by-products are obtained to pay most, if not all, of the costs of operating the plant, but a large source of electric power becomes available at a cost much lower than it could be bought from our hydroelectric installations. Calcium cyanamide as a fertilizer offers a practically unlimited market which cannot be overstocked for a good while to come. The ease with which it can be used in an endless number of reactions in the manufacture of organic chemicals is well known. Next to the all-important soda-industry, this utilization of our lignites appears to be the industrial development with the most brilliant future.

The tar from the producer furnace or coke oven has a well-established market value. It can, however, well be used in a tar-refinery, producing not only the more commonly known tar products such as phenols, pitch, etc., but also the cyclic hydro-carbons, viz., benzol, toluol, cresol, napthaline, anthracene, etc., which opens the long vista of synthetic coal-tar products culminating in an analine dye industry.

The last requirement for a successful industrial development, cheap iron for our apparatus and machinery we do not have, at least not now. We have large deposits of excellent iron ores, but we lack the all-important supply of cheap coke. All attempts to use liquid or gaseous fuel instead have not as yet proven successful, nor will they ever do so in my opinion. I have stated above that my researches make it seem probable that good coke will finally be obtained from some of our lignites, but this remains to be proven. All we can hope for at present is the successful development of the reduction of iron ores in the electric furnace, which we can very materially assist by a probable reduction of the cost of electric power by using our lignites as outlined above.

In my discussion, I have deliberately refrained from advocating any industrial development, for the success of which our raw-materials, available markets and local conditions do not only promise a highly remunerative investment at the present prices of like manufactured products, but also place us on an even footing with the industrial centers of the world, thereby enabling us to command our share of export trade. In additon, I have only advocated well-known and tried methods. No new and untried inventions or secret processes are required for our success. True, we must not expect success by using iron-clad method or recipes, which have been elaborated for other local conditions than our own. We must benefit by the experience of Europe and our own Eastern States and intelligently adapt their methods for our use.

I certainly am aware of the difficulties in the way of making California the home of a large and prosperous chemical industry. Our investors are generally not familiar with the nature and vast possibilities. There is a tremendous amount of educational work to be done before we can hope for a substantial success. On many occasions, I hear the candid opinion that for the purpose of chemical industrial pursuits, it is necessary to import a German, French, English, etc., chemist. This is by no means the case. Our American chemists are second to none. The only thing lacking is that our investors are surely excellent judges of engineers, bookkeepers, skilled and unskilled workmen, but they fail to realize the fact that chemists are representative of just such an exact science as the civil engineer. We are too often considered to be no more or no less than a visionary drug clerk or an uncanny trance-medium. Many of our manufacturers would rather spend a fortune on a misty secret-process than pay an adequate remuneration to a competent chemist. We must combat most energetically this erroneous idea. Let us all stand together to emphasize and insist upon a realization of the fact that a chemist is not only an analyst but a very important factor in the general industrial development and the one paramount factor in the chemical industry.

If we succeed, if we create a soda industry utilizing our deposits of alkalies, if we start the use of our lignites as a raw product for the cyanamide and coal tar industry, if we assist in finding ways and means to reduce our iron ores, then we shall realize that our State is not only capable of producing its own chemical products, but is in some directions even more favored than other industrial centers. Instead of being the last outpost of civilization, California, through the shifting of the world's activities and the completion of the Panama canal, has become a center for the world trade highways. Nothing can do so much in making it a center in the industrial world as the development of a large and varied chemical industry. We have all the favorable conditions required and it rests primarily with us to realize them. In this effort, I ask for your hearty coöperation, as well as the coöperation of our colleges and manufacturers.

Los Angeles, Calif.

The Future of Electrochemistry and Metallurgy on the Pacific Coast*

BY J. W. BECKMAN

I BELIEVE the Pacific Coast holds a better future for the manufacture of electrochemical and electrometallurgical products than most parts of the world. This opinion is formulated after having traveled through Europe all the way from northern Sweden and Norway down to the southern part of Italy, visiting electrochemical centers.

These electrochemical centers are located where engineering skill finds that hydroelectric power can be developed at a reasonable price and where raw materials can be obtained readily. There are electrochemical plants in Norway north of the Arctic circle. The only access to those plants is by water route; the raw material is brought in from all parts of the world by boat and the finished products are shipped out from these plants by water. You could find conditions of a similar nature in most electrochemical centers of Europe. The primary factor is cheap power; availability of raw material is secondary, while the proximity to markets for their products as a rule is the third factor. We, on the Pacific Coast, are blessed by an abundance of water power, much of which can be developed at a very low figure provided sound and wholesome financing is done. We have on the Pacific Coast

*Extracts from a paper read May 24, 1918, before the American Institute of Electrical Engineers. Author is president, Beckman & Linden Engineering Corporation, San Francisco.

large mineral resources, some of them practically untouched as yet, suitable for electrochemical or electrometallurgical manufacture. We have in Alaska situations identical with those on the coast of Norway, where power can be obtained at low figures on tidewater. We have stupendous opportunities on the Columbia River in Washington and we have the possibility of power developments all through the Southern Sierras.

In Europe, installations as small as a few hundred horsepower are used for electrochemical industries, and the day will come in California and the Pacific Coast, when we will find electrochemical industries located all through our mountains, where water powers even of small dimensions are available.

The quicker electrical engineers can realize that the big consumers of hydroelectric power are the electrochemical industries the better. The quicker the California hydroelectric development can realize that the day of the public service plant has passed for them the better. Future developments of the water powers of California and the Pacific Coast are not to be made for the lighting of dwellings and running of street cars, but for the industrial development of the state and to some extent for the operating of the railroads of the country.

Electrochemical Industry a Good Power Consumer

Without any question the best consumer that any power producer can have is an electrochemical or electrometallurgical industry. They run on a power factor 90 per cent and better and as close as possible to a 100 per cent load factor. They run day and night the year around. The electric furnace load is a larger load than the electrolytic load. The largest electrolytic plant in the United States, I believe, takes about 10,000 kw., while the largest electric furnace plant in the United States absorbs 150,000 kw. The electric furnace load is built up by a few large units, while the electrolytic load is built up by a great number of small units.

We have as yet only a few electrochemical and electrometallurgical industries on the Pacific Coast. We have a few electric steel furnaces, but I think we have made a fair beginning and the opportunities are standing wide open. With the shortage of power in the East and with the increased demand for electrochemical products that not only exists today but will continue to exist, the future holds big opportunities in my estimation, along electrochemical and electrometallurgical lines for the coast states. We need badly a basic industry—such as iron production—but we hold in our hands all the essentials for a pig-iron industry similar to that of Sweden. Swedish iron is known all over the world with highest regard. California iron could be equally well known and equally well spoken of. We have enormous iron deposits—there is scarcely a county in this state that does not contain iron deposits and there are a number of them that have very large deposits of high-grade iron ore. For instance there is one deposit which is estimated to contain about 250,000,000 tons of 65 per cent ore.

Sweden reduces its ores by means of charcoal, made incidental to their lumber mill operations. It is produced either in by-product charcoal ovens or by heap charcoaling. The Pacific Coast holds more timber than Sweden and Norway combined, but charcoal is a scarce commodity here. Therefore, to be able to develop an iron industry, it is essential that the timber and woodworking industries co-operate in producing charcoal.

Electricity Replacing Charcoal in Sweden

The electric shaft furnace is a complete success in Sweden. Every charcoal furnace that goes down for reconstruction is replaced by an electric shaft furnace; due primarily to the fact that one ton of charcoal will produce three tons of pig iron in an electric furnace, where before it produced only one ton in a charcoal furnace. The iron industry of Sweden is located in the very heart of Sweden, distant from the seaboard, and in a very limited area.

We have had unfortunate experiences in California in all attempts at making pig iron, but with the experience gained in Sweden we should be able to manufacture pig iron successfully for the needs of our present and future industries. The power necessary for this is available in large quantities in this state waiting to be developed. Blast furnaces are now being built in Sweden, taking up to 10,000 hp., and a few of these installed in this state would quickly show their influence in the metal markets.

The manufacture of electric steel is another industry which is needed here in conjunction with the pig-iron industry.

Nitrogen Fixation a Large Field

Another big field for the development of electrochemistry and the power of this state is in the artificial fertilizer field. There are large stretches, as I understand it, of the valleys of California that contain excellent soil conditions and would be fertile fields, provided nitrogen in the shape of some fertilizer could be supplied them. Air is available everywhere, hydroelectric power can be developed at many points and at very low cost. We can either fix atmospheric nitrogen in the shape of nitrate or we can fix it in the shape of cyanamide, a large supply of lime rock is available and cyanamide answers many times as a fertilizer as well as nitrate.

In mentioning these developments I believe I have given the most important electrochemical industries suitable for large power developments. We have a large possible field for minor industries in the manufacture of alloys and chemicals. Many of these naturally are dependent on their possible market outlet, and I believe it is an important thing to remember on the Pacific Coast that our ligitimate market, on which we should spend our efforts for the selling of our products, are not east of here, but west of here. The big industrial developments of the future are going to take place in China, Japan, Australia, and the countries south of us. We have golden opportunities there and the quicker we realize it the greater will our results be.

There is a tendency, and I want to warn you against it, for the Easterners and Eastern interests to say that it is impossible for us to accomplish such things in the West. It is a very natural, conservative tendency of people not acquainted with localities to make such judgments, but the important thing for us is to compare our resources with those of other localities on the globe where things have been accomplished in spite of handi-

caps. I am especially referring to the Scandinavian countries. Sweden and Norway are to-day factors—large factors—in the electrochemical field in spite of being handicapped by a lack of raw material and by distant markets. Another thing we have to bear in mind is that no industry was great before it was small. The only thing to do to build up the Pacific Coast's electrochemical industries is to copy what was done elsewhere; start them in a small way and gradually build them up to large ones. This, in turn, can only be accomplished by a close co-operation of electrical engineers and chemists of the Pacific Coast.

San Francisco, California.

The Evaluation of Zinc Dust: A Proposed Method of Analysis*

BY L. A. WILSON.

ZINC dust, or "blue powder," as it is commonly known, is being used in constantly increasing amounts for organic reductions, sherardizing, precipitation of gold and silver in cyanide practice, and in certain classes of paint.

Due to the demands of the trade for a material superior to the ordinary spelter furnace blue powder, the zinc dust sold to-day is largely a specially prepared product. The two particular qualities usually demanded by the consumers of zinc dust are fineness and high metallic zinc content.

The fineness is best determined by microscopical examination, but as usually carried out in practice, it is a simple matter of careful screening a sample through a nest of screens. On the other hand, the determination of the metallic zinc content, or reducing power as metallic zinc, is not so easily obtained and determinations by different methods or even by the same method with different analysts will show considerable variations. Since the manufacturer analyzes his product to maintain the grade, and the consumer is likely to analyze the zinc dust which he buys to preclude against accepting inferior material, there is need for a standard method that may be followed without great detail and which will obviate the misunderstanding originating from variant analyses. It is the purpose of this paper to cover only the determination of the metallic zinc contents of zinc dust, and not its physical properties.

HYDROGEN EVOLUTION METHOD ADOPTED

After experimenting with the various proposed methods, the hydrogen evolution method was adopted because it was found to give the most consistently accurate results. The method and apparatus to be described later are the outcome of experimental work extending over several years, starting with the apparatus proposed by Franz Meyer and adding improvements and modifications as the work progressed. The method and apparatus have been used for hundreds of determinations for metallic zinc in zinc dust, and have given more accurate results than any method described in literature. For this reason they are proposed as a standard means for determining the metallic zinc contents of zinc dust.

*Excerpt of a paper, subject to correction and modification, presented at the Twenty-First Annual Meeting of the Amer. Soc. for Testing Materials, Atlantic City, N. J., June 25-28, 1918.

The procedure and apparatus recommended for this method are fundamentally the same as in the Franz Meyer method.[1] By re-arrangement of apparatus and improvements in details of the procedure, the accuracy of determining the metallic zinc content of zinc dusts has been raised and the time required materially shortened. The average time required for high-grade zinc dust of which 90 to 95 per cent passes a 350-mesh sieve, and contains less than 0.3 per cent of metallic impurities, is about 1½ hours, against 2 to 4 hours with the Franz Meyer apparatus. With the latter apparatus there is no satisfactory way to speed up the determination, shaking being only mildly effective. In the proposed new method, the addition of strong acid accomplishes this purpose. The method and apparatus may be best described with the aid of Fig. 1. A 1-g. sample of zinc dust is weighed and transferred as rapidly as possible to a small Erlenmeyer flask *A*, of 100 or 200-cc. capacity, in which is placed a piece of sheet platinum about 1.5 cm. square. About 5 g. of clean unoxidized ferrous sulphate crystals are added on top of the zinc dust and the flask nearly filled with distilled water saturated at room temperature with hydrogen gas. The object of adding the sheet platinum and ferrous sulfate is to increase the rate of hydrogen evolution by catalytic action. A further reason for adding the ferrous sulphate on top of the zinc dust sample is to coagulate the latter as much as possible when it becomes wetted, and thus prevent the floating of more than an unappreciable amount of the sample.

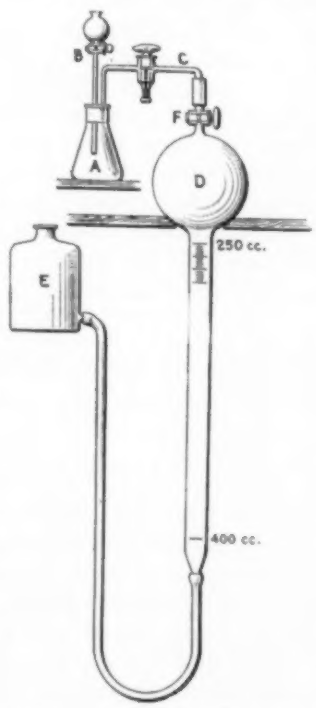


FIG. 1—APPARATUS FOR EVALUATION OF ZINC DUST

The rubber stopper containing separatory funnel *B* and connecting tube *C* is tightly inserted into the neck of the flask. A little distilled water is poured into *B* and the three-way stopcock in *C* turned to connect the flask with the downward outlet. Enough water is now run in from the separatory funnel to displace all the air in the flask and the connecting tube through the bore in its stopcock. The stopcock in *C* is now turned so that the downward outlet is in connection with the measuring tube *D*. By raising the leveling bottle *E*, containing 10 per cent sulphuric acid also saturated with hydrogen at room temperature, all the gas in *D* is displaced. The stopcock in *C* is now turned through 90 deg., so as to connect the decomposing flask *A* with the measuring tube *D*. The system is hence completely filled with liquid and ready for the generation of hydrogen. The measuring tube *D* has a total capacity of 400 cc. and is graduated from 250 to 400 cc. by 0.25 cc.

[1]Scott's "Standard Methods of Chemical Analysis"

Thirty cubic centimeters of 1:1 sulphuric acid are now poured into the separatory funnel. A small portion of this acid is allowed to run into the decomposing flask until a brisk but not too rapid evolution of hydrogen takes place. The acid, being much heavier than water, settles to the bottom of the flask and the action commences immediately. The gas evolved, together with some solution and a very small amount of zinc dust passes over into the measuring tube, displacing the acid there. When the action in the decomposing flask has slowed down, more strong acid is introduced until all has been added. During this time the acid in the measuring tube and flask is shaken so as to wash down the particles of zinc dust from the upper parts of the flask and tube now filled with gas. The particles in the measuring tube on coming in contact with the 10 per cent sulphuric acid are readily dissolved and generate their portion of hydrogen.

When all the zinc dust has been dissolved, water is run in from the separatory funnel to force the hydrogen over into the measuring tube and to fill the flask and connecting tube with water through to the stopcock *F*, which is then closed. After leveling with the leveling bottle the volume of hydrogen generated from the 1-g. sample at the prevailing atmospheric conditions is read from the measuring tube. The percentage of metallic zinc in the sample is then calculated from the following expression:

$$\textit{Per cent of metallic zinc} = \frac{V \times (P - p) \times 0.29196}{(1 + 0.00367t)\ 760}$$

in which V = volume of gas in measuring tube at atmospheric conditions, P = barometric pressure, p = vapor tension of water above 10 per cent sulphuric acid at room temperature, and t = room temperature.

Necessary Precautions.—To obtain results of the highest accuracy, it is necessary when weighing out samples of zinc dust which are very finely divided, to keep the time of exposure as small as possible in order to minimize the oxidation that takes place with the oxygen of the air. It si also highly important when samples are to be held, that they be kept in ground glass stoppered bottles, completely filled, and sealed with paraffin or wax.

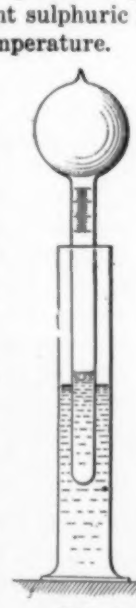


FIG. 2 CORRECTION TUBE.

The two variables most likely to affect the results are temperature and barometric pressure. A change in the barometric pressure is practically always extended over a reasonable length of time. A careful reading of the barometer when the volume of gas in the measuring tube is read will eliminate any error from this source. A temperature change, on the other hand, affects not only the volume of gas, according to Boyle's law, but also affects the vapor tension of water and hence the actual pressure on the hydrogen when measured. Unlike barometric variations, changes in temperature can to a large extent be avoided by making the analyses in a room maintained at a nearly constant temperature, enclosing the apparatus in a cabinet, with door fronts that are opened only when measurements are to be taken, and keeping all water and acid saturated with hydrogen in the same cabinet.

The rubber connection between the connecting and measuring tubes must be of heavy rubber and should be shellacked.

Apparatus for Correcting to Standard Conditions Directly

Where a large number of metallic zinc determinations are carried out daily, the matter of calculating the results becomes laborious and is occasionally a point of error. This can be done away with in a simple manner.

A measuring tube, similar to the one used for measuring the gas, is sealed at the top below its stopcock filled with mercury and placed in a glass cylinder containing mercury.

Hydrogen, perfectly dry, is now introduced until it fills less than half the graduated stem of the tube. After leveling, this volume is read very accurately together with the room temperature and pressure. As a check, this volume may be read at another temperature. The volume is calculated to standard conditions. Enough pure water is now introduced into the measuring tube to entirely cover the mercury. After equilibrium has been attained, the volume temperature, and pressure are read and the dry volume of hydrogen calculated will check with the original volume introduced. Fig. 2 shows this apparatus in readiness for use.

The volume of gas in this tube will vary according to atmospheric conditions, but since the volume of dry gas at standard conditions is known, the factor to correct the volume of hydrogen gas evolved in a determination to standard conditions is a simple matter of calculation, as given by the following expression:

$$\textit{Per cent of metallic zinc} = \frac{V_D \times v_s \times 0.29196}{v_d}$$

in which V_D = volume of gas evolved in determination, v_s = volume of dry hydrogen in correction tube reduced to standard conditions, and v_d = volume of hydrogen in the correction tube read at the same time as V_D.

Where the amount of work carried out would warrant it, a table may be made up giving the factor for each graduation on the tube. The factor is the calculated result of $\frac{v_s}{v_d} \times 0.29196$, where v_d is the volume for each graduation. We can now directly convert the gas volume in the measuring tube after each determination directly over into percentage of metallic zinc.

The vapor tension of water is slightly lower above 10 per cent sulphuric acid than above pure water, and the error that would be introduced by taking the volumes in the correction tube directly would give results ordinarily about 0.3 per cent low.

The table of factors calculated is corrected to take this into account. This difference is indicated in Fig. 3, which shows the curves of vapor tension of water above pure water and dilute sulphuric acid plotted against temperature. The curves are for the following:

A = Vapor tension above pure water;

B = Vapor tension above sulphuric acid containing 10.89 g. H_2SO_4 and 100 cc. water;

C = Vapor tension above sulphuric acid containing 18.4 g. H_2SO_4 and 100 cc. water. This solution is 10 per cent H_2SO_4 by volume and the curve was obtained by interpolation, using curves B and D;

D = Vapor tension above sulphuric acid containing 32.02 g. H_2SO_4 and 100 cc. water.

It will be seen from curves A and C that where the temperature changes over a large range the use of a correction tube will give slightly erroneous results, due to the increasing difference in vapor tension above water and 10 per cent sulphuric acid with increasing temperature. In this case, results should be calculated, using

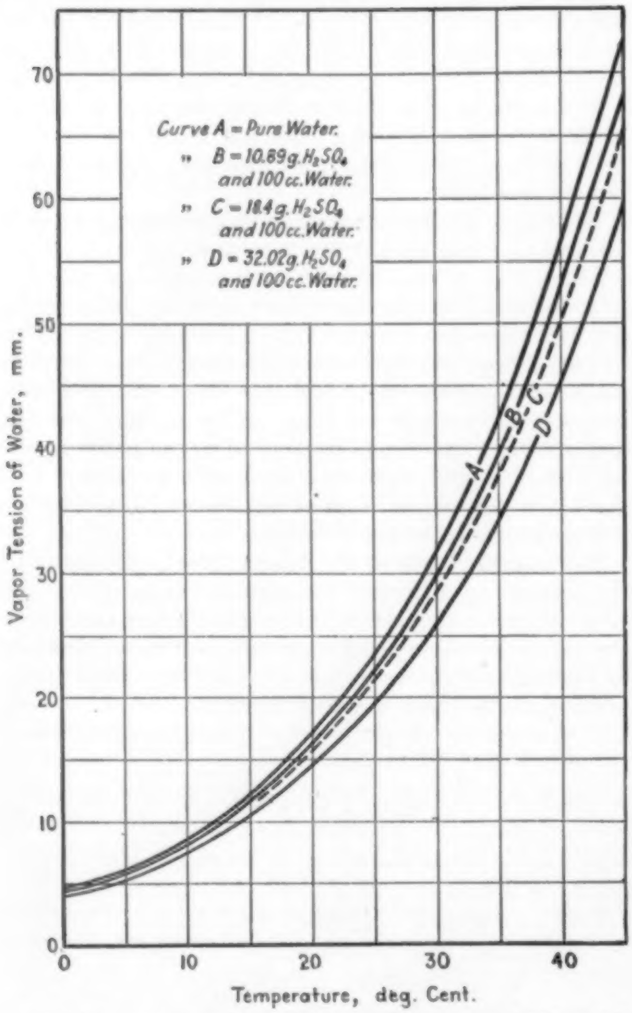


Fig. 3.—Vapor Tension of Water above Pure and Dilute Sulphuric Acid. Data for curves A, B and D from Landolt-Bernstein. page 167. Curve C interpolated.

the elementary formula. Where the laboratory temperature is controlled, the correction tube gives satisfactory results and is a valuable additional piece of apparatus.

In this proposed method all known possibilities of error have been taken into account and accurate reproducible results are obtained. The results of many analyses extending over a long period of time, and the running of many check samples as unknowns, have confirmed this and prompt the putting forward of this method and apparatus as a standard means for determining the metallic zinc content of zinc dust.

Gold exports from the United States during eleven months of the fiscal year ending June 30 have exceeded imports by $95,000,000. This, as it happens, is the largest net export in the country's history and compares with $661,000,000 excess of gold imports in the same period a year ago.

Government Badly Needs Trained Men

With a perfect organization at home for producing the material of war, victory will be easier. The actual fighting forces must have the constant support of a host of highly trained experts if the nation's greatest undertaking is soon to be successful. The United States Civil Service Commission, whose duty it is to recruit the Civilian army, announces that right now the civilian branches of the Army and Navy are in urgent need of thousands of technical men to work in direct connection with the prosecution of the war.

Among the positions now open are the following:

	Usual entrance salary
Metallurgist	$3,000 a year
Assistant chemist and metallurgist	$2,000 a year
Metallurgical chemist	$1,600 to $2,400 a year
Assistant metallurgical chemist	$1,000 to $1,600 a year
Metallographist	$1,500 to $2,000 a year
Assistant chemist	$1,800 to $2,000 a year
Junior chemist	$1,200 to $1,440 a year
Powder and explosives chemist	$1,600 to $2,400 a year
Assistant powder and explosives chemist	$1,000 to $1,600 a year
Chemical engineer	$1,600 to $6,000 a year
Assistant chemical engineer	$1,200 to $1,600 a year
Superintendent of high explosive and acid plant	$1,500 to $1,800 a year
Laboratory aid	$4.00 a day
Toluol expert	$1,800 to $3,000 a year
Operative in gas manufacture	$1,600 to $2,400 a year
Assistant operative in gas manufacture	$3.00 to $5.00 a day
Superintendent of nitrate and chemical plants	$2,400 to $6,000 a year
Assistant superintendent of nitrate and chemical plants	$1,600 to $2,400 a year
Engineering draftsman	$3.04 to $7.04 a day
Mechanical draftsman	$4.00 to $8.00 a day
Apprentice draftsman	$480 a year
Metal furniture draftsman	$4.00 to $6.00 a day

A further long list of technical positions in the War, Navy, and other departments are to be filled. For the positions named applicants are not required to report at any place for examination, but are rated upon their education, training, and experience, and in some cases on work submitted with the application. Physical ability is also considered in some instances. Ratings are arrived at from information set out in the application blank and from corroborative evidence.

The Civil Service Commission calls particular attention to the fact that all necessary information concerning civil service positions, and application blanks therefor, may be obtained free of any cost by applying to the Commission's representative at the post office in any important city, or by addressing "The United States Civil Service Commission, Washington, D. C." Positions of junior chemist and many of the drafting positions are open to women.

Chicago Men Unite for War Work

A score of the leading Chicago Engineering and Technical Societies have organized a Joint War Committee: Chairman, F. K. Copeland; Vice-Chairman, W. L. Abbott; Treasurer, W. A. Fox; Secretary, E. S. Netheralt, 1735 Monadnock Block, Chicago, Ill.

Board—Wm. Hoskins, C. A. Keller, C. E. Lord, C. F. Loweth, I. Randolph and R. S. Schmidt.

The purpose of this organization is to get the various technical men together and combine their individual efforts in rendering any aid of value in scientific work, pertaining to the war.

The Possibilities of Powdered Coal as Shown by Its Combustion Characteristics*

An Exposition of the Merits of Powered Coal Based on Its Efficiency and Flexibility to Meet Varying Demands—Advantages of One-Stage Combustion—Importance of Thorough Mixing

BY W. G. WILCOX

INDUSTRIAL efficiency and the smooth operation of the machinery of industry require continuous supplies of power, materials and labor. These are of equal importance in that the lack of any one of these is equally disastrous.

The wonderful work being done by women in Great Britain and France shows us that we also have great reserves of labor hitherto unsuspected and as yet practically undeveloped. When we regard the percentage of available men put in the field by both France and Great Britain—when we know that their industrial production is nevertheless carried on today at a high peak due to the utilization of women in industry, we can rest assured that the solution of our own labor shortage will follow along identical lines. The problem is by no means insurmountable.

PRESENT FUEL SITUATION

Power and materials, the other two factors that make up the balanced ration of industry, are bound up in each other. No matter how great the resources in raw material, these will be of no value unless the power necessary for transportation, manufacturing and fabrication is available. The greatest source of power is through the combustion of fuels. The situation in regard to fuel is so alarming as to call for the most careful consideration. Production of fuel scarcely meets consumption. Regional Director for the U. S. Railway Administration, R. H. Aishton, formerly president of Chicago and Northwestern Railway, states that "There were times last winter when there was not four hours' fuel in the city of Chicago between freezing people to death and keeping them warm." This is not the statement of an alarmist but of a man, who as director of all the great coal-shipping railroads of the Middle West, knows the facts. Concomitant with the greatest demand for coal we have ever experienced we find the greatest natural-gas field of West Virginia failing alarmingly. This brings into the list of coal consumers new users who have formerly depended on natural gas. At the same time fuel oil is steadily becoming harder to obtain and almost prohibitive in cost. The oil-fired forge furnaces of the East and the copper reverberatories and cement kilns of western Texas, Arizona and Utah, the potash producers of Nebraska and the apartment houses of Seattle, alarmed at the fuel-oil situation must and are seeking coal as their salvation. This means another new demand for coal, a further burden on railroad transportation. As the railroad must have more coal to haul more coal the seriousness of the situation increases geometrically.

For this situation with all the elements of danger it presents there are three possible solutions:

1. Stimulation of the production and transportation of fuel,
2. Developing efficient methods for utilizing low-grade fuels hitherto practically unused, and
3. Burning fuel so much more efficiently than we now do that the amount available will be adequate for all needs.

An estimate of the possibility of speeding up coal production and coal transportation can be left to those who are at present arguing the pros and cons of whether it is the railroad or the mine which limits production. At best there does not seem to be much reason to expect any great increase in production.

Our greatest opportunity for success in meeting the fuel situation lies in the efficient combustion of both low-grade and high-grade fuels. It is far wiser to save avoidable losses than to increase supply and thus compensate for losses. It is preëminently the patriotic and professional duty of the chemist and engineer to work for the more efficient utilization of fuel. We should therefore study critically the lines along which we should work. Among the more efficient types of combustion is the use of powdered fuel. By considering the nature of powdered coal as a fuel and its combustion characteristics we can learn its possibilities in the present fuel situation. The requirements necessary in perfect combustion show the weaknesses of present methods and the possibilities of powdered coal combustion.

What are the known avoidable losses in combustion? What are the essentials necessary for combustion efficiency?

ESSENTIALS OF GOOD COMBUSTION

Assuming correct furnace and flue design, and proper and controlled draft, the essentials of good combustion are:

1. *Complete oxidation of all the combustible in the coal to avoid loss of combustible in ash and up the stack.* The loss of unburned carbon in the ash will vary with different types of fuel, different types of ash and the percentage of ash in the coal. It will also vary with the type of stoker used and boiler load carried. In hand-fired practice it will vary with the skill of the fireman; and in producer operation it will vary according to the quality of the coal, type of producer and operating conditions.

Using an Illinois coal of the following analysis:

	Per cent
Sulphur	5.5
Volatile matter	34.0
Fixed carbon	42.0
Ash	18.5

*Paper delivered before the Western New York Section of the American Chemical Society, May 31st, 1918

the results of one of the large users in the Middle West show the following losses in the ash:

	Actual per cent of coal lost
Over-feed stokers—25 per cent unburned carbon in the ash	4.6
Chain grate stokers—35 per cent unburned carbon in the ash	6.5
Hand fired—35 per cent upwards unburned carbon in the ash	6.5 and upward

This particular consumer has two different types of stokers and also does a large amount of hand-firing. His consumption is over 100 carloads of coal per day; operation is under the direction of skilled technical men who have actual data as to losses.

In producer operation using a good-grade coal, 20 per cent of unburned carbon in the ash is the minimum figure. Under bad conditions when poor, fine, wet coal was used and with variable steam pressure, as high as 55 per cent unburned carbon will be found in the ash even with a first-class modern producer.

With any type of stoker or producer the loss due to unburned carbon in the ash increases with the increasing ash content. This is not a straight-line function, partly due to the human element, while the increase in unburned carbon with increasing ash is affected considerably by the nature of the ash, its fusibility, etc. Certain coals, although of high heating value, offer enormous difficulties to efficient operation when put through a producer, burned on grates or on stokers. A case in point is a coal obtained in southwestern Virginia not far from Bristol, Tenn. This coal runs over 14,000 B.t.u. and contains under 8 per cent ash. Occurring in this coal are fine laminations of pure crystalline transparent calcite which is present in just sufficient amount to flux the other ash materials and given continuous trouble from clinkering. Even in a modern mechanical producer this coal is a source of continuous trouble and interruption of operation. Due to the mechanical occurrence of the ash washing does no good.

Another case is a Colorado coal of the following analysis:

	Per cent
Ash	6.66
Volatile matter	43.76
Fixed carbon	49.58
Sulphur	0.93
B.t.u.	12886

The ash of the coal melts, runs down on the grates and freezes there while the coal itself disintegrates and chokes up the fire.

There is, of course, also the loss of unburned carbon up the stack which although as much as one or two per cent under some conditions should be small with good operation.

2. *Control of combustible and air.* This is absolutely essential, if we are to secure maximum flame temperature with a corresponding increased rapidity of heat transfer. The more rapid the heat transfer in the furnace or boiler the higher the capacity of the furnace and, in general, the greater the efficiency. This may well be shown by the following example: The theoretical flame temperature for hydrogen is 2010 deg. C.; while with 25 per cent excess air, this figure drops to 1764 deg. C. This fact has long been realized in boiler practice and considerable emphasis has been placed on high content of CO_2 in the flue gases and a minimum amount of excess air.

3. *Control of flame length.* In order to maintain in a furnace the conditions which the design of the furnace, the operation, or the metallurgical process occurring therein, requires, it is essential that the length of the flame be under control. An example is found in a recent development in firing copper reverberatory furnaces. For a long time it has been a practice to fire copper reverberatories with an insufficient amount of air, admitting the amount of air required to complete combustion at ports along the side of the reverberatory. It has recently been found with oil-fired reverberatories that if the number of oil burners firing into the furnace is increased and the mixture of oil and air so adjusted as to give complete combustion with a short, hot flame, the capacity of the furnace is increased in some cases as much as 50 per cent, while the fuel ratio is better than anything yet obtained with oil in reverberatory practice. This is also true of powdered-coal-fired reverberatories. In this particular operation it has been found that a short, hot flame leads to most efficient operation and highest furnace capacity; but there are other processes in which the reverse is true.

Economies Effected by Powdered Coal Through Furnace Efficiency

In changing types of fuel, for example in changing from the hand-firing of coal to powdered-coal combustion, the economies met with are usually far greater than those which can be figured from the known losses. The increase in capacity is usually so great that it can only be attributed to increased furnace efficiency. This increased furnace efficiency in all probability follows from the fact that the operator is now able to maintain the flame length and type of combustion for which that particular furnace design is best suited. When, in changing from hand-fired practice to powdered-coal combustion, it is found that only from 30 to 40 per cent as much coal is used as formerly, the greater proportion of the saving is very evidently due to change in the efficiency of the furnace.

4. *That type of combustion which is to be most efficient must possess flexibility in capacity.* Flexibility in combustion means rapid response. Only in this way can a cold furnace be brought to heat very quickly or a standby boiler come up to peak load rapidly. This makes for efficiency because it reduces the fuel consumption during the standby period. Many operations also require considerable variation in heat input at different stages of the operation; in order to secure highest efficiency under these conditions, extreme flexibility as to "combustion load" is demanded.

5. *Control of the nature of the combustion.* In many operations it is not only necessary to heat uniformly, quickly and efficiently, but it is equally important to maintain a certain chemical condition in the furnace. This condition may be oxidizing, reducing or neutral. In any case the control of combustion should be such that the desired condition may be maintained within very close limits; failure to do so means a waste of fuel. Maintaining an oxidizing condition without ability to control it within close limits, will result in having present too much of an excess of air, which will lower flame temperature, lessen output, lower furnace efficiency and reduce fuel efficiency. Likewise a reducing condition, unless maintained within close limits, means that fuel is needlessly wasted. If the operation demands a neutral condition, there may be some loss

due to spoiling of product, unless there is the ability to maintain the neutral condition quite exactly.

One-Stage Versus Two-Stage Combustion

6. *One-stage combustion.* The best example of two-stage combustion is the producer. The producer affords, in many of its applications, an overall efficiency which is considerably higher than that obtained by other methods. Nevertheless we should clearly realize that in the process for making producer gas there is an inherent loss of at least 20 per cent because of the inability to gassify without forming a certain percentage of CO_2, due to heat losses at the producer and losses in sensible heat from the gas between the producer and the point at which it is used.

There is another serious objection to two-stage combustion. When combustion is completed, the final flame temperature is lower than in a one-stage process. Unless we resort to such devices as the recuperator or regenerator, high temperatures cannot be reached. Furthermore a two-stage combustion results in "cracking" some of the most valuable constituents of the coal with the formation of smoke in the furnace and soot in the producer. This has been shown very well by Kreisinger, Augustine and Ovitz in *Bulletin* 135 of the Bureau of Mines, in their study of the combustion of coal and furnace design.

Having considered the essentials for efficient combustion, we can correctly estimate the value of powdered coal as an efficient fuel, by studying its characteristics, and seeing to what extent these make it possible to maintain the essentials of good combustion. In the same way we can also ascertain the conditions demanded for success in the combustion of pulverized fuel.

Fuel Characteristics of Powdered Coal

The simplest way to regard the combustion of coal is that it is a reaction between solid fuel and oxygen. It is therefore a heterogeneous system; consequently the velocity of the reaction and its completeness will depend upon the surface exposed by the solid, the pressure of the reacting gas and the intimacy of the mixture. By grinding an inch cube of coal so fine that 85 per cent will pass a 200-mesh screen, we have increased the surface exposure from 6 square inches to aproximately 1800 square inches. We have therefore increased the velocity of combustion approximately 300-fold. By doing so, we have immediately changed the characteristics of the fuel. We now have a fuel relatively 300 times more active than the inch cube of coal, a new type of fuel which has in it inherent possibilities not met in lump or slack fuel. By increasing the surface exposure 300-fold, we have speeded up combustion proportionately. This carries with it a further effect. The increase in combustion velocity also increases the rapidity of heat evolution, and consequently quickly raises the temperature of the rest of the material. This temperature rise, which is much more rapid than in the normal combustion of coal, will double the velocity of combustion each rise of 10 deg. C. The increased velocity due to greater surface exposure and that due to temperature rise are superimposed on each other so that we have with pulverized fuel a combustion which is hundreds of times faster than when burning lump coal.

Having a finely divided fuel it is possible to form a mixture of fuel and air so intimate that each small particle of coal is surrounded by the proper amount of air. In this condition, by maintaining the proper velocity of the air current, the fuel can be carried into the furnace in suspension and there burned completely, efficiently and rapidly.

Essentials for Combustion Efficiency

It is of course a simple matter to mechanically control the amount of powdered coal delivered to the furnace in a given time. It is also quite possible to control the amount of air delivered with the coal. If, then, we deliver to the furnace an intimate mixture of air and powdered coal and have control of the amount of coal dust and air delivered, we have the prime essentials for highest combustion efficiency. These are the possibilities in utilizing coal in powdered form. The degree to which they are attained depends entirely upon how carefully we study the characteristics of the fuel before and during combustion.

The amount of coal dust delivered to the furnace can be controlled simply and positively by using as a feeder a properly designed screw, operated at variable speeds. It is also a simple matter to control the volume of air admitted with the fuel. But the highest efficiency possible with this type of fuel will not be obtained unless we work out a correct way in which to mix a finely divided solid with air.

A study of the methods for making such a mixture, immediately shows that the methods commonly used in making uniform mixture of two miscible liquids or a uniform solution of a solid in a liquid, or the methods used in mixing finely ground solids are not only useless in this case, but will actually separate the coal dust from the air. Ordinary mixing is done by agitation; this agitation is usually accomplished by baffling, stirring, shaking or similar devices. When, however, such methods are applied to a mixture of gas and finely divided solid, the solid tends to separate out due to its much higher specific gravity. This, in fact, is the principle of the well-known Cyclone dust collector. Any mixing device which results in such agitation of the dust and air as to give a centrifugal effect, will tend to separate out instead of mixing the air and the dust. Any mixing device along these lines must necessarily fail to give an intimate, perfect mixture.

The importance of intimately mixing the coal dust and air cannot be exaggerated. The rapidity of combustion is a direct measure of the intimacy of mixture. This is well illustrated by comparing the ordinary gas flame with the flame obtained in the Bone combustion system. The Bone system consists in forcing the proper proportions of air and gas through a diaphragm having numerous small interstices which results in a mixture that is nearly perfect. When this mixture is ignited on the other side of the diaphragm, we have only a film of flame.

Importance of Thorough Mixing

The poorer the mixing the longer the flame. The flame simply outlines the area in which combustion is taking place and the length of the flame is a measure of the time element necessary to accomplish combustion. This time element—other conditions being equal—is

absolutely a function of the intimacy of mixture. This has already been noted by Breckenridge some ten years ago, when in *Bulletin* No. 325 of the United States Geological Survey, page 171, he stated:

> "The conclusion is reached that the velocity of combustion decreases enormously from the surface of the fire to the rear of the combustion chamber, where it is relatively very small, the practical application is that little is to be gained by adding further length of smooth combustion chamber, which would be commercially as poor an investment of capital as to add to the length of a Corliss engine cylinder and stroke; we must resort to thorough mixing."

On page 178 of the same bulletin, Breckenridge further stated:

> "Mere length of combustion chamber counts for little —that mixing is what counts."

These two excerpts from Breckenridge's study of four hundred steaming tests have since been amply confirmed by the work of Kreisinger, Augustine and Ovitz, in *Bulletin* No. 135 of the Bureau of Mines. The work of these investigators confirmed and emphasized the previous observations of Breckenridge and they quote him as I have. They also state on page 130:

> "Evidently, the length of the flame depends not only on the nature of the combustible, the excess of air, and the rate of firing but also to a large degree on the rate of mixing of the combustible gases with the oxygen of the air. It has been shown that the tendency of the gases is to flow in parallel streams even when the air was introduced into the furnace in many small streams through the tuyeres of the furnace."

So far we have considered this type of fuel from the point of view of the possibilities which it affords. We have also studied the characteristics of the mixture of coal dust and air in order to ascertain what methods should be employed to insure delivery to the furnace of an intimate, controlled mixture of fuel with the requisite amount of air. A fuel having the great possibilities offered by a finely divided combustible, is of extreme importance especially under present conditions. Because of these possibilities, all of which are capable of being realized and which are satisfied by commercial equipment now on the market, there is less excuse for permitting inefficient operation with this fuel than with stoker or hand-fired practice. Apparatus, properly designed and fundamentally correct in principle, will give proper efficiency. Such apparatus by giving an intimate and controlled mixture of fuel and air to the furnace will permit the highest furnace efficiency.

Characteristics of Powdered Coal and Fuel Oil

Just as in the past there has been a remarkable failure to realize the necessity for intimately mixing air and coal dust, neither has there been sufficient consideration of the characteristics of this fuel when burning. Powdered coal has the characteristics of a rich fuel of somewhat higher kindling temperature than producer gas, natural gas or fuel oil. To illustrate the fact that it is a rich fuel, we can compare the available B.t.u. in a cubic foot of a correctly proportioned mixture of powdered coal and air and the available B.t.u. in a cubic foot of a correctly proportioned mixture of pure methane and air. Taking a Pittsburgh vein coal (heating value 14,157 B.t.u.) of the following analysis:

	Per cent
Volatile	35.4
Fixed Carbon	58.5
Ash	6.1

we find that a cubic foot of a correctly proportioned mixture of coal dust and air has available 107 B.t.u., while a mixture of pure methane and the proper amount of air has available per cubic foot, 62.3 B.t.u.

A further illustration is shown by the theoretical maximum flame temperatures of several fuels.

THEORETICAL MAXIMUM FLAME TEMPERATURE USING COLD AIR

	Deg. C.
Hydrogen	2010
Carbon Monoxide	2050
Natural Gas	1806
Pure Methane	1958
Pittsburgh Coal (Analysis given above)	3470

Factors Controlling Rapidity and Completeness of Combustion

The rapidity of combustion and the completeness of combustion of a mixture of coal dust and air depends upon a number of factors:

1. *The velocity and pressure at which it is passed into the combustion chamber.* If the velocity of the incoming stream of powdered coal and air is above the velocity of flame propagation, combustion will not take place until the mixture has slowed down to a point where it does not exceed the velocity of flame propagation. When powdered coal is fired at high pressure and high velocity, combustion frequently does not begin until a point four to six feet from the mouth of the burner. A similar example is found in the plumber's blow-torch when too much air is used, or in the Bunsen burner when the gas pressure is too high. High-pressure, high-velocity firing not only slows down combustion thus increasing the size of combustion chamber necessary, but has a destructive action on the furnace. It has been well established that high velocities in the combustion chamber or a blow-torch effect due to firing at high pressure (whether oil or gas be used as a fuel) are always very destructive to the brick work. This action is increased in high-pressure firing of powdered coal since in addition to the erosional effect of gases at high temperature traveling at high velocity, there is a fluxing action by the melted ash. Furthermore, with such high-velocity combustion, the slagged ash will be carried along mechanically, leading to further furnace troubles. In one case this resulted in a serious deposit of slag on the mud drum of a vertical waste-heat boiler at the end of a long reverberatory furnace. Slowing down the velocity not only hastens combustion, but makes it possible to eliminate much of the slag. When the velocity is low the coalesced particles of slagged ash are either larger than will be carried by the velocity of the gas or this condition is so nearly approached that a slight change in direction of the flame will result in dropping out the slag. Thus, in addition to being correct combustion and necessary in order to avoid excessive furnace maintenance costs, low-pressure, low-velocity combustion permits by slight change in flame direction dropping out a very large percentage of the slagged ash in the early part of combustion, where it can be removed and will not interfere seriously with efficient metallurgical operations.

The velocity of combustion is not only dependent upon the fineness of the particles of coal, intimacy of mixture and the velocity of the stream of combustible and air, but is affected by the temperature of the combustion chamber. The kindling temperature of a mixture of powdered coal and air is

higher than either that of oil or gas; consequently for successful and complete combustion, it is necessary that the combustion chamber be maintained above a certain minimum temperature and that combustion is practically complete before the products of combustion pass over the heat absorbing surfaces. Just as you can extinguish a gas flame by passing over it a piece of wire gauze, so the effect of a chilling surface will be even more marked with this combustible material than burning gas, since the particle of coal is infinitely larger than a molecule of gas and the kindling temperature is also higher. This has a direct application in the successful firing of locomotive-type boilers, water-tube boilers and return-tubular boilers. If the combustion of powdered coal is not sufficiently developed before the flame enters the tubes of the locomotive-type boiler, combustion will be checked and coked coal settle out in the tubes. If on the other hand combustion is sufficiently developed before the flame is brought in contact with the heat-absorbing surface, a complete combustion and high efficiency are obtained. In any furnace operation and in furnace design, this must be borne in mind if success is to be expected.

Rapidity of Combustion of Low-Pressure Mixture

A study of the flame developed by a low-pressure, intimate mixture of coal dust and air shows that combustion is extremely rapid. In a copper reverberatory furnace in Florence, Colorado, where this type of combustion is used, coal burned at the rate of approximately one ton per hour develops a flame which vanishes within six feet of the burner, combustion being complete at that point. In order to bring out exactly what this means, let us translate it into terms of natural gas, in which case the fuel consumption would be approximately 26,000 cubic feet per hour or 433 cubic feet per minute. Picture to yourself this quantity of gas being burned at low pressure and developing a flame only six feet long. Gas samples taken in the flame, show a content of CO_2 as high as 16 per cent only five feet from the mouth of the burner. This will give an example of the rapidity with which combustion can be obtained and the extremes which are possible in shortening the flame. It is equally possible with proper equipment to lengthen the flame until it will spindle out a distance as great as 100 or 120 feet. However, with an intimate controlled mixture, this must be done by supplying insufficient air. Under such conditions combustion is incomplete and the flame spindles out because combustion continues to develop throughout the length of the furnace as air leakage supplies additional oxygen. This is an additional proof of the statement previously made that the length of flame is an actual measure of efficiency of mixing and the adjustment of the fuel-air ratio.

Thus it is seen that we have changed entirely the characteristics of coal as commonly known. Powdered coal is a fuel of extreme flexibility in that the amount burned can be varied within wide limits. It is a fuel which develops a flame the length of which can be adjusted. The character of the flame can be altered to suit the metallurgical operation. In short the basic fuel, coal, has acquired the characteristics of oil or gas, but with better and closer control than in the case of oil or gas. Furthermore, the possibilities of this fuel are not only capable of realization, but are actually being utilized in commercial practice today. To the flame characteristics of a rich fuel, developing a flame like oil or gas, is added a degree of control not yet obtainable in burning either oil or gas. This statement is made advisedly. The possibilities of such combustion for the improvement of processes, for fuel economy, for increasing output, through its ease of control and elimination of heavy labor, are today realized by few. Due to the psychological attitude of labor and the scarcity of skilled operatives, it is far more difficult than ever before to secure high efficiency and good operation in hand-firing, stoker-firing or in producers—in short wherever such efficiency depends upon constant watchfulness and hot, heavy, disagreeable work. For these conditions powdered coal substitutes an ease of control such that the equipment can be handled by an old man or a boy, while it is so simple that a man of ordinary intelligence can soon be taught all that is necessary for good efficiency in operation. The possibilities of such control in the place of present day combustion methods, which permit high efficiency only by the most strenuous effort, through substituting for these a type of combustion whereby high efficiency is easily obtained, is certainly of great importance to us at the present time.

Control of Heating Conditions in Chemical Processes

To those who are in touch with many diversified chemical industries, the possibility of maintaining within close limits, heating conditions which are oxidizing, reducing or neutral at will, conditions which once adjusted will remain constant—barring mechanical or electrical interruptions—will undoubtedly suggest many cases where such combustion will offer new economies and betterments in their processes. A good example of this is shown in a powdered-coal installation in a malleable iron foundry in Buffalo. The positive and simple control offered by their equipment has not only resulted in the highest fuel ratio yet reached in malleable-iron practice, namely between 5 and 6 lb. of castings per pound of coal, but also through maintaining a slightly reducing condition in the annealing oven the oxidation of the cast-iron pots has been so reduced that the cost of pots per ton of castings has been cut from $2.25 to 83 cents. These two results are concrete proof of the possibilities of this type of combustion. The high fuel-ratio shows efficient combustion; the decrease in pot cost shows control of combustion; and the high fuel-ratio in conjunction with the maintenance of a reducing condition shows exactness of control.

A still more striking example of the possibilities of controlled combustion may be cited of a powdered-coal installation now being made. In this particular process a cast-iron container is maintained continuously at a temperature of 1000 deg. C. This is not only close to the melting point of the material but is a temperature so high that the oxidation caused by the unavoidable excess of air met in ordinary methods of combustion results in enormous maintenance costs due to quick failure of the container. In this installation it is confidently believed that the combustion can be so controlled as to cut oxidation to a minimum so that the life of the container will be greatly increased.

Effects of Administration Efforts at Fuel Distribution

The Fuel Administration has wisely districted the coal fields of this country. In doing so they have upset in many cases what has been standard practice for years in some of the industries. The cities of Iowa have for years used anthracite for house heating; today they must use Iowa and Illinois coal. The malleable-iron foundries of Chicago have in the past bought Elkhorn coal from Kentucky with which to melt iron in the air furnace; today they are confronted with the problem of using high-sulphur, low-grade, Middle Western fuel. While temporary relief will undoubtedly be granted through permits to use high-grade coal for melting, it is probably only a question of time before they will be compelled to work out successful methods for burning the lower-grade coals of their immediate vicinity, from which they should naturally draw their supply of fuel. Nebraska must learn to use her lignites, as must the Dakotas. Western Texas must do the same. Seattle, which has in the past heated apartment houses with fuel oil, must learn to do so with the lignitic coals of Washington.

While these communities are facing the problem involved by the use of these low-grade fuels, every user is experiencing a marked decrease in the quality of his coal, regardless of the source. In the J. E. Aldred lecture delivered at Johns Hopkins University this year by Mr. E. G. Bailey, he shows that due to the enormous demand for fuel, shortage of labor and other conditions, the ash content in coal has increased during the year of 1917 at least 5 per cent, resulting in an increase in coal consumption, due to the decreased heating value and lower efficiency, which reaches as high as 10 per cent. Figuring on a basis of six hundred million tons of coal produced and marketed last year, thirty million tons of dirt, slate and rock were handled in excess of what the coal would normally contain. At a price of $2.50 f.o.b. mine and a freight rate of $1.50 per ton, the consumer has paid $120,000,000 for worthless material. The additional cost of firing this coal, repairing furnaces, stoker and locomotives and the cost of handling the ashes, will add some millions of dollars more.

The coal consumer today is obtaining not only a poorer grade coal than formerly but a coal much more difficult to burn efficiently, due to increased content of sulphur balls, slate and bone. Not only is this true, but a big variation in the quality of coal leads to further inefficiencies. Stoker practice and our present settings are largely designed for a particular type of coal of a certain grade. The flexibility of such equipment in handling efficiently considerable variations in quality of fuel and nature of ash is limited. Under such conditions powdered coal by reason of its characteristics as a fuel offers us in many cases a solution of the problem.

Burning Low-Grade Fuels in Suspension

In burning low-grade fuels in suspension the only loss in efficiency is that due to lower flame temperature caused by the increasing amount of ash and the heat lost in the ash. Coals running as high as 30 to 40 per cent ash can be successfully burned; combustion will be complete and maximum flame temperature for that fuel will be obtained. The only difference between burning a fuel of this type and a high-grade fuel is the difference in flame temperature and the heat loss in the slagged ash. An ash whose slagging character would lead to enormous difficulties in producer or stoker operation will simply melt the easier when the coal is burned in powdered form and can therefore be dropped out earlier in the furnace, which in many cases constitutes an actual advantage. The lignite fuels of the Middle West and the Far West can be burned successfully and are being burned successfully in powdered form. An enormous field is opened up through ability to burn with efficiency these lower-grade fuels. It will eliminate long hauls of fuel by our railroads, release motive power and cars, and conserve our fuel reserves.

An unusually good illustration is found in two coals previously mentioned, one a Virginia coal more than 14,000 B.t.u. and less than 6 per cent ash, and the other a Colorado coal. Both of these are practically unavailable as fuels when using stokers, grates or producers, because of the chemical nature of the ash and its mechanical form. When, however, these coals are pulverized, the distribution of the ash in the lump coal has no effect, while the low melting-point of the ash in many cases offers a decided advantage. These coals both afford splendid fuels of high heating value when burned in powdered form. The Colorado fuel is being burned successfully this way. The River Smelting and Refining Company which is burning this Colorado fuel has cut the fuel requirements per ton of ore smelted in a reverberatory to ⅓ that necessary when this coal was burned on grates.

It has been the object of this paper to discuss the unusual characteristics of powdered coal as a fuel; not only the characteristics of the fuel before being burned, which of necessity dictate the principles which must be made use of in designing proper equipment and which give us an idea of the possibilities offered by this fuel, but its more striking possibilities have been shown. Many of these are actually being obtained commercially today. From your knowledge of your own industries, no doubt many other possibilities will suggest themselves to you.

Chicago, Ill.

Gasoline Recovery from Natural Gas.—Gasoline recovery from natural gas by compression and refrigeration has been systematically treated in *Bulletin* 151, Bureau of Mines, by W. P. Dykema. Conditions of actual operation and the equipment in use are described. The vapor pressure of gasoline being relatively low compared to that of marsh gas, etc., it has been found that the percentage content of gasoline decreases greatly with high pressure, so that the most favorable sources of supply are low pressure gas wells. Up to five or six years ago, coils were used by most operators in compressing 200,000 to 300,000 cubic feet daily. The gas used yielded from four to six gallons of gasoline per 1000 cu.ft. of gas. At present, plants are in operation having multiple compression with elaborate cooling effects, in which as much as 9,000,000 cu.ft. of low-grade gas is used having only one gallon of gasoline per thousand cubic feet. From 100 to 300 barrels of water are required for cooling 1,000,000 cu.ft. of gas at 250 lb. per square in. working pressure per day.

Chemical and Metallurgical Notes from Japan

By Katsu Yasui

Potassium Chlorate

Prior to the present war, there was only one factory manufacturing potassium chlorate in Japan, with an electric power consumption of 2850 kw. hr. According to late government reports, the number had increased to seventy factories in August, 1917, with a power consumption of 14,000 kw. hr.

Matches

Instead of being one of the chief imports to the Orient, matches have now become one of the principal exports (of Japan), a trade being even established in America. The statistics for last year are:

	Cartons—12 Boxes	Value
Common match	445,112,000	11,662,000
Yellow phosphorus	146,372,000	1,974,500
Specialties	15,870,000	267,500
Total	607,321,000	13,904,000
	Cases	
Exports	41,321,000	10,551,500

The price of matches has advanced with the general rise in raw materials. The average price per carton and the total value of the yearly production have been compiled as follows:

	Per Carton	Value of Production
1912	\$0.13	\$7,073,000
1914	.16	7,772,000
1915	.23	11,385,000
1917	.27	13,904,000

Nitrogen

The government has made a large appropriation of money to help create a domestic nitrogen industry, in recognition of the indispensability of nitrogen products for agriculture, industry and ordnance. The statistics for local production in tons are:

	1913	1914
Ammonium sulphate (tons)	7,400	15,900
Calcium cyanamide (tons)	2,500	5,000

The imports in 1913 were:

	Tons	Value
Ammonium sulphate	110,000	\$8,000,000
Sodium nitrate	26,500	1,450,000

About 60 per cent of the sodium nitrate was used in industrial and explosive works, the remainder, for agriculture. During the war, the demand has been threefold times as great and the supply very inadequate.

Tin Plate and Cans

The Nitto Steel Manufacturing Co. of Kawasaki, near Tokyo, has increased its capital to \$2,500,000, and has started the construction of a tin-plate department with a capacity of 15,000 tons per annum. The Oriental Can Manufacturing Co. has placed orders in the United States for can-making machinery and is waiting for delivery which is very slow because of the present scarcity of ships.

High-Speed Steel

The Japan High-Speed Steel Works, near Tokyo, which was founded by Mr. Totaro Ezaki, is being greatly enlarged and will have 40 rolling mills and steam hammers. Capital \$1,500,000.

CYANIDE AND MERCURY IMPORTS

	1915	1916	1917
Potassium Cyanide:			
Quantity (tons)	330	513	246
Value	\$181,896	\$324,578	\$195,337
Sodium Cyanide:			
Quantity (tons)	175	270	270
Value	\$82,175	\$138,348	\$161,970
Mercury:			
Quantity	137	284	200
Value	\$216,693	\$639,674	\$464,691

ORES MINED

Gold	1,554 oz.
Silver	41,800 oz.
Copper	8,400 tons
Iron	7,573 tons
Coal	1,815,637 tons
Sulphur	5,242 tons
Petroleum	160,000 barrels

CHEMICAL MANUFACTURING CENSUS

Industry	No. of Factories	Employees
Ceramic	962	49,293
Paper	277	21,309
Lacquer	5	192
Leather	48	3,968
Powder	255	31,177
Oil and wax	74	4,619
Pharmaceutical	183	9,281
Rubber	99	8,178
Toilet goods	21	1,021
Color, paint, paste	69	2,695
Fertilizer	58	6,277
Miscellaneous	63	4,049
Total	2,146	143,631

Molybdenum

Molybdenum ores have been found at Gifu Prefecture, Onari-gun; Toyania Prefecture, Shinkawa-gun; Niigata Prefecture, Kambara-gun; Totori Prefecture, Nogi-gun and Ohara-gun; and Hyogo Prefecture, Shishikuri-gun. While only 5.6 tons were mined in 1914 and 11.1 tons, in 1915, the output is expected to increase greatly, making Japan one of the prime producers of molybdenum.

Trained Men Wanted by Bureau of Mines

Important chemical and other technical engineering work necessary for the prosecution of this war is being carried on by the Bureau of Mines Experiment Station, at Washington, D. C. The services of trained men of the following classifications are urgently needed:

Bacteriologists	Instrument Makers
Biologists	Laboratory Assistants
Chemists, Inorganic	Laborers
Chemists, Organic	Machinists
Chemists, Physical	Physiologists
Chemists, Electro-chemical Engineers	Plumbers
	Steamfitters
Draftsmen	Stenographers
Electrical Engineers	Skilled labor of various kinds

If your training fits you for any of these occupations, send to the

Bureau of Mines,
American University Experiment Station,
Washington, D. C.

for blank forms. When properly executed and returned by you, these forms will be placed on file, and when a vacancy occurs you will be considered for it and will be notified if your services are desired.

If you are a registrant in the draft, and have not yet been ordered to camp, it may be possible to have you immediately inducted into the service for work here. If you are not in the draft, but feel that you wish to serve your country in the present crisis, you can enlist, or serve as a civilian.

Synopsis of Recent Metallurgical and Chemical Literature

Occluded Gases in Ferrous Alloys.—The February, March and April *Journal* of the Franklin Institute contains an important contribution on the above subject by GELLERT ALLEMAN and C. J. DARLINGTON of Swarthmore College. The first part of the paper contains an extensive review of the literature, showing the extremely various results and views attained by individual investigators. Troost and Heutefeuille in 1873 concluded that gas bubbles formed on solidifying metal were forced out of solution on cooling. Parry in 1881 found that his former results were somewhat in error owing to the fact that the iron carbide in the metal reacted with the silica of the container, giving carbon monoxide gas and a high silicon alloy. This fact was controverted by Baker (1909) but re-established by the present authors. Parry's results were received with much skepticism on account of the large volumes of gas obtained—up to 340 volumes. Pourcel in 1882 investigated the effect of various ferro-alloys in reducing the number of blowholes in steel ingots, and concluded that aluminum or silicon steel contained no gas if no manganese were present, but 2 per cent manganese occluded large quantities of hydrogen. Henry M. Howe (1892) wrote that the gases nitrogen, hydrogen and carbon monoxide dissolve in molten iron and their escape is what causes blowholes. Braune (1903-1906) concluded, however, that nitrogen was present as nitride, probably $Fe_xN_{x'}$, and its presence could be detected microscopically by observing the increase in crystalline structure of the ferrite grains, closely resembling uniform pearlite on high nitrogen contents. von Malitz (1907) concluded that heating melts to a very high temperature diminishes the tendency of iron to absorb hot gases, but Sieverts (1910) found the opposite. Boudouard (1907) found that evolution of gases commenced in all cases at a red heat, while repeated heatings did not entirely remove the gas. He also records that volatilization of the iron commences at 900 deg. C. and is very noticeable at 1100 deg. C. Baker (1909) concluded that mechanical work diminished the volumes of the evolved gas some 50 per cent. He failed to find the appreciable dissociation pressure to be expected if the gas were due to the decomposition of ferrous compounds, and therefore thought that the gas was imprisoned as such in the pores of the steel, to be driven out on heating in vacuo. On the other hand Heroult (1910) and Goerens (1910) say that cold steel of any manufacture does not contain any appreciable amount of gases, blowholes being formed largely by carbon monoxide produced by reaction between carbides and oxides. Sieverts (1910) found that nitrogen was absorbed by gamma iron only.

HYDROGEN OCCLUDED INCIDENTAL TO ELECTROLYTIC ACTION MAKES IRON BRITTLE

Large quantities of hydrogen are occluded by iron incident to electrolytic action, making it very brittle. Roberts-Austin (1899) thinks that a critical point of 481 deg. C. is due to the formation of a hydride, and another at 261 deg. C. of an eutectic. Iron in an acidulated solution absorbs hydrogen at a point lower than the decomposition voltage, using up chemical energy to change the molecular structure of the iron.

The present authors think that these divergencies are largely due to the porosity of the containers at high temperatures, allowing infiltration of air and flame-gases, and also to the fact that the heating was not sufficient. Preliminary experiments indicated that quartz tubes reacted with the metal, rapidly devitrified and became porous. Special alundum tubes, 1 in. diameter and 24 in. long, were consequently wound for 5 in. with 20 ft. of No. 20 molybdenum wire, plastered with alundum cement and wrapped with two layers of asbestos rope. This tube was centered into a welded iron jacket, 8 in. diameter by 10 in. long, entering through 2 in. nipples at each end. The joint at this point is sealed with alundum cement, wound with okonite tape and covered with rubber cement. The whole protruding ends are then covered with a glass bulb, one of which is connected with an air pump. The heating current is led in through the iron casing by two iron bolts cemented into flanged openings by alundum cement and rubber stoppers, on the outside of which were layers of bakelite and rubber cement. It is absolutely necessary that a vacuum as complete as possible be maintained in a perfectly gas-tight container, else the molybdenum wire will burn readily. With this apparatus a temperature of 1800 deg. C. may be gradually attained and maintained for 5 minutes.

HYDROGEN LARGEST CONSTITUENT OF GAS EVOLVED AT 950 DEG. C.

Experimenting with iron wire at about 950 deg. C. they found hydrogen to be the largest constituent of the gas evolved, no oxygen or carbon monoxide being found. Basic open hearth steel (1.05% C) evolved 198 volumes of gas after 35-hours heating in a quartz tube at from 940 to 1470 deg. C., the gas consisting of 60 per cent carbon monoxide, while another sample more rapidly heated gave a mixture containing 80 per cent CO. Bessemer steel (0.08 C) heated 23 hours at 1100 deg. C. evolved 55 volumes of gas consisting largely of hydrogen. The same steel heated in the improved furnace in an alundum boat evolved 220 volumes of gas of the following analysis:

Gas	At 1,000° C.	At 1,250° C.	At 1,500° C.	At 1,675° C.
Illuminants	0.00	0.00	0.00	0.00
Carbon dioxide	1.08	0.62	0.00	0.00
Oxygen	2.4	3.07	4.28	6.25
Carbon monoxide	48.9	56.10	18.75	8.42
Hydrogen	21.16	15.08	4.20	1.10
Nitrogen	26.46	25.13	72.77	84.23
Total	100.00	100.00	100.00	100.00

The authors conclude that the gases are mostly evolved from interaction of iron oxides, nitrides, carbides and hydrides, certain of which exercise deleterious effects on the steel, and the removal of which will show marked change in microstructure and increase in density. Hydrogen is most readily freed, carbon monoxide next, and nitrogen is held tenaciously. So-called deoxidizers may act as a catalyst to prevent occlusion of gas at high temperature or promote its elimination at lower.

Recent Metallurgical and Chemical Patents

Denitration of Sulphuric Acid.—INGENUIN HECHENBLEIKNER, of Charlotte, North Carolina, patents the process and apparatus of denitration of sulphuric acid together with the oxidation and hydration of the nitrogen oxides in one operation, recovering thereby a pure nitric acid. As shown in Fig. 1, he introduces nitrified acid from tank 13 through the distributor, whence it trickles through the tower-filling against rising steam introduced through pipe 11. The nitrous gases thus driven out by the steam are oxidized and hydrated to form nitric acid by the oxygen blown in through distributor 18, oxidation being particularly rapid in the presence of ozonized air. As a great amount of steam must be utilized for denitration concentrated sulphuric acid is showered through the distributor head 21 in the upper part of the column for the purpose of removing part of the water contained in the nitric acid fumes. Concentrated sulphuric acid is preferably used because it possesses manifest advantages for drying nitric acid fumes which contain a relatively great amount of surplus steam. Furthermore, the sulphuric acid thus added equalizes the concentration of the denitrated sulphuric acid escaping through the siphon 12, since denitration cannot be completed if the concentration of the sulphuric acid is less than 60%, while for practical purposes the best denitration can be accomplished by a concentration of between 60 and 70% sulfuric acid. The dry nitric acid vapor is drawn into the condenser, conventionally represented at 22, where the pure material is recovered. (1,264,512; assigned to the Southern Electro-Chemical Co., April 30, 1918.)

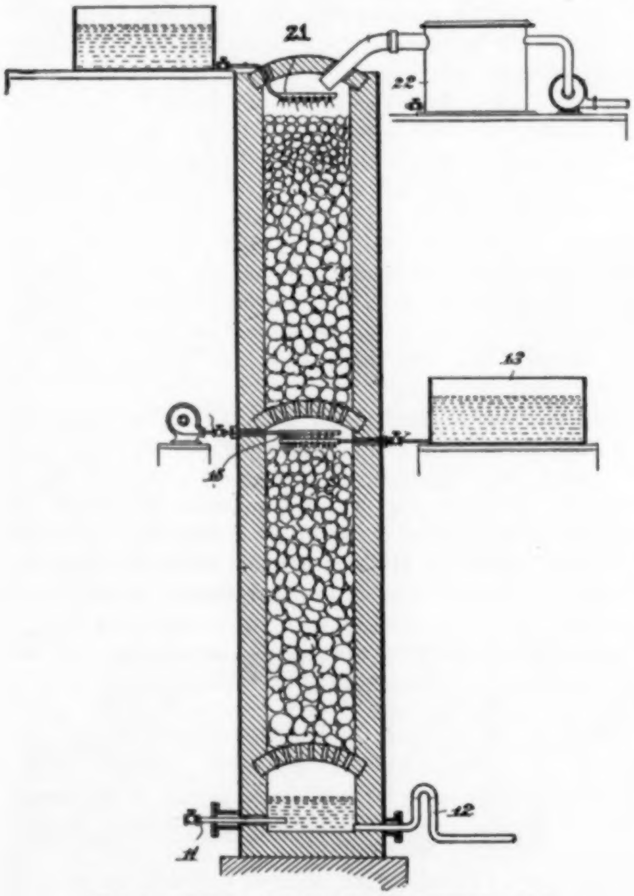


FIG. 1—DENITRATION OF SULPHURIC ACID

Process and Apparatus for Concentrating Acid.—INGENUIN HECHENBLEIKNER of Charlotte, North Carolina, patents the apparatus for producing 98 per cent sulphuric acid shown in Fig. 2, together with the process of operation. The weak acid is introduced at the top of the tower 10b, and trickles down through the acid proof filling against a counter current of hot gases. A fan drives air through the bustle pipes 5 and tuyeres 7 into the bath of acid. The air is previously heated to about 400 deg. C. by gas or oil burners at the ends of the fire-brick lined pipes 5. The heated air agitates the bath and absorbs water at a temperature below the boiling point of the acid, issuing at the surface of the acid at a temperature of about 200 deg. C. This heat is largely transferred to the descending droplets of weak acid in the checkerwork above. In order to catch the last trace of acid in the cooled gases exhausting through pipe 15, a condenser 16, filled with acid-proof material is employed. The weak acid recovered here is drawn off from the air seal bottom, as is also the concentrated acid from the bath 8. By removing the moisture without boiling the acid no substantial loss in acid is experienced, while the method is also claimed to utilize heat very efficiently. (1,264,509; assigned to Southern Electro-Chemical Co., and 1,264,182; April 30, 1918.)

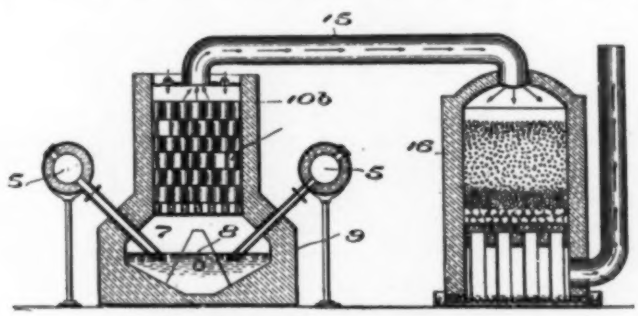


FIG. 2—CONCENTRATION OF SULPHURIC ACID

Separation of Potassium Salts.—GUY STERLING, of Salt Lake City, Utah, patents a process for recovering a mixture of potassium and sodium salts from the mother liquors of natural brines which usually contain a large amount of magnesium salts. He mixes about 0.8 parts by weight of the mother liquor salts with 0.5 parts of silica, and 0.85 parts of limestone, all finely powdered. He then heats the mixture to about 1400 deg. C. for three hours, stirring the mass, when the potassium chloride, potassium sulphate, and sodium chloride largely sublime, leaving behind a complex calcium-magnesium-sodium-silicate. A magnesium-free concentrate is thus produced. (1,264,572; Apr. 30, 1918.)

Production of Percarbonates.—OTTO LIEBKNECHT, of Frankfort-am-Main, Germany, patents the process of precipitating percarbonates from hydrogen peroxide sodium carbonate solution with excess of sodium chloride. (1,263,258, May 21, 1918.)

Pulverized Fuel Burner.—T. B. CRAM, of Chicago, Ill., patents the burner illustrated in Fig. 3, whereby a short, hot flame may be had when burning pulverized coal. Air enters through pipe 8, a portion of which passes through nozzle 17, sheathing a jet of pulverized coal entering through pipe 16 with a layer of cold air travelling at a considerably higher velocity. This

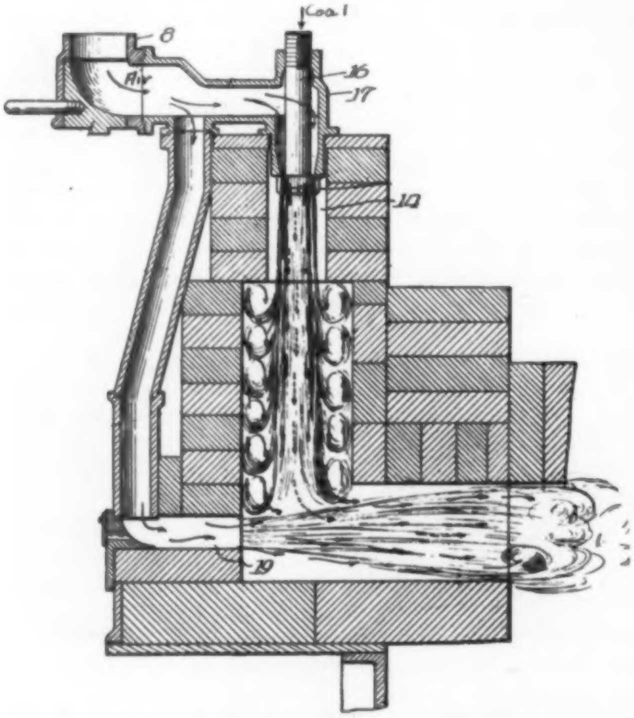


FIG. 3—PULVERIZED FUEL BURNER

sheath keeps the metal parts and the upper opening 14 cool and free from flame and at the same time sets up a swirling motion as indicated in the vertical combustion chamber. The fuel ignites and partially burns in this chamber, at the lower part of which it meets at an angle a stream of air coming through pipe 19 containing sufficient oxygen for completing the combustion, which is effected immediately in a short, hot, and smoke-free flame. (1,258,654; Mar. 12, 1918. Assigned to Railway Materials Company.)

Agglomerating Oxidized Ores.—A. S. DWIGHT, of New York City, patents a method of utilizing the familiar Dwight-Lloyd roaster for the agglomeration of oxidized material, especially iron ores. He notes that the formation of silicates so desirable when sintering sulphide ores must be avoided in a treatment of oxidized ores preliminary to their being smelted. He therefore feeds a well mixed stream of ore, carbonaceous material and flux on the pallets. The carbonaceous material is ignited and its conbustion sufficiently heats and reduces the oxidized ores that the various basic oxides form componds below the temperature of silicate formation. The ore mixture is spread in a thin layer so that the heated gases readily escape without the formation of hot pockets where silicates might be formed. A sufficient excess of carbon is placed in the original mixture so that at the end of the process enough will remain to complete the reduction to metallic state on further smelting. (1,254,316; Jan. 22, 1918.)

Chromium Compounds of Azo Dyes.—RENE BOHN and PAUL NAWIASKY of Germany have found that chromable azo coloring matters containing at least one hydroxyl and one sulphuric acid group can be made to yield soluble chromium compounds by being heated with a chromium salt in the presence of water. It is equivalent whether the free sulfonic acid or hydroxyl groups or a salt of such groups be present. The azo coloring matters which are derived from ortho-aminophenols or ortho-ammino-naphthols or anthranilic acid or benzidine disulphuric acid or toluidine disulphonic acid or from a derivative of any one of these compounds are useful for this purpose whereby in particular salicylic acid and derivatives thereof may be employed as the other component. The new compounds are soluble in water and have an intense color and can be applied for printing purposes, the compounds thus obtained being better and more completely fixed and consequently faster than the prints obtained by applying the chromable azo coloring matter in the presence of a chromium salt to the fiber. The new compounds, after being printed on the fiber, can be fixed by means of alkaline reagents, such for instance as sodium carbonate, or ammonia, and thus differ from the mere mixtures of cromable azo compounds and chromium salts which cannot suitably be fixed by such a process. Four examples of the process are described in detail. (1,264,604; Apr. 30, 1918; Assigned to Badische A. & S. Fabrik.)

Burner for Dwight-Lloyd Roaster.—S. E. FRASER, of Port Pirie, South Australia, patents an improved burner for igniting the ore stream on a Dwight-Lloyd roaster shown in Fig. 4. It comprises a number of special refractory bricks strongly bound together with iron bars and rods and shaped to form a shallow, inverted elliptical dish. Blow torches 8 introduce a

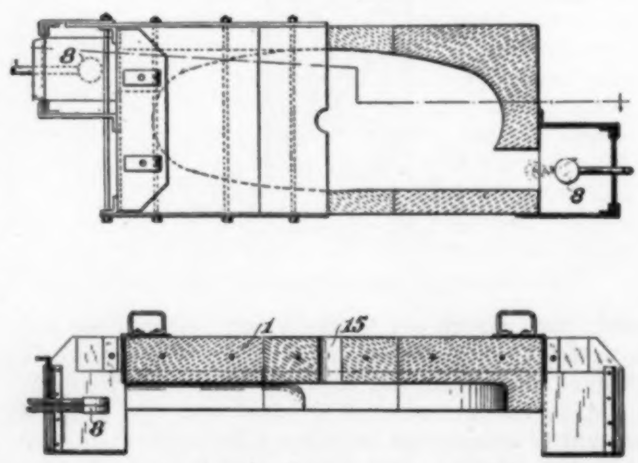


FIG. 4—PLAN AND ELEVATION OF DWIGHT-LLOYD ROASTER

flame tangently, and in operation the dish is filled with a swirling flame playing above the moving ore stream, heating by contact and radiation from the incandescent brick dish. Additional air may be introduced through openings like 15 as necessary. (1,262,580; Apr. 9, 1918.)

Extraction of Resins and Turpentines.—DAVID J. OGILVY, of Cincinnati, Ohio, patents an improvement over the usual methods for the extraction of resins

by digestion of woods with such solvents as petroleum distillates, pine oils, turpentines, etc. He employs a digestor practically filled with conifer chips which is connected to a still set at a lower elevation and filled with a mixture of resin solvent and water. This mixture is heated and its vapors enter the bottom of the digestor, extracting the resins, oleoresins and turpentines in the wood, which extracts are carried back into the still in the return condensate through the connection pipe. A reflux condenser is placed above the extractor to catch the uncondensed water and solvent passing up through the wood contained in the digestor. When the operation is completed, the still containing the watery liquid and the resinous magma is connected with an exhaust condenser and a preliminary separation made of the resin solvents, turpentines and oils. The resinous magma and watery liquor remaining in the still are separated and the magma used for the production of resinous substances. The inventor claims that his process may be conducted at a lower temperature, and the continual presence of water vapor is an additional precaution against fire and explosion. The water and steam have a disintegrating action on the wood, allowing readier attack of the solvent, which itself is attenuated and used to maximum efficiency by the same agents. (1,264,551; April 30, 1918.)

Arc Adjustment in Steel Making.—WM. E. MOORE, of Pittsburgh, Pa., notes that it is desirable to use a long arc when melting solid metal in an electric furnace. This long arc gyrates over a large area, and local short circuits by molten metal are therefore not so troublesome. The high heat of such an arc is not particularly damaging to the furnace roof, since the unmelted metal absorbs radiations much more completely than after it is covered with a glassy slag. During the refining process, therefore, it is preferable to shorten the arc considerably. The inventor proportions the electrical circuits for the low voltage arcs of the refining cycle, and increases the voltage only during the melting stage, from say 40 or 60 volts up to 120 or 240. This practice reduces the size of the electrical conductors, switches, and other accessories, as well as bettering the power factor by reason of less self-inductance and counter electromotive force. The inventor also utilizes the rectified current produced during the furnace operation to heat the bottom just sufficiently to prevent formation of accretions and to stir the bath. He presents a number of wiring diagrams for different conditions of current and arrangements of electrodes. (1,242,464; Oct. 9, 1917.)

Coke Oven.—THEODOR VON BAUER of Germany patents a new coke oven constructed to operate on the regenerative principle and so arranged with combined vertical and horizontal flues that the heat can be increased from the top of the retort downward. This prevents decomposition of the valuable by-products in their passage through a previously coked portion of the charge, and provides an increased heat for the denser botto mportions. In Fig. 5 preheated air from regenerator u′ and gas from the main de enter the top horizontal flue e, passing into flue g through vertical passes f. Here the burning gases are mixed with more air and gas introduced through the heads of the oven walls. Entering flue i the hot gases receive further supplies of air and gas through a number of openings leading downward from a double channel h. In order to simulate surface combustion conditions, these gases—now containing an excess of combustible,

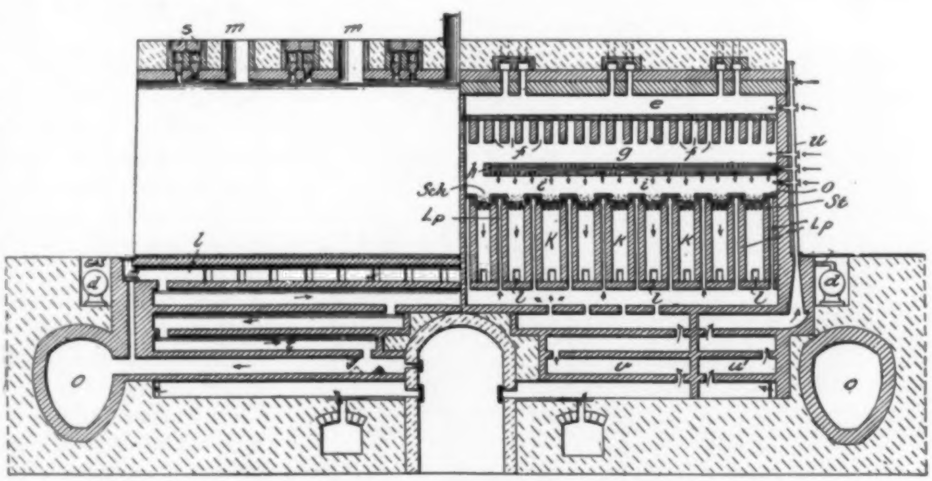


FIG. 5—REGENERATIVE COKE OVEN

pass into vertical flues k through the mass of broken chamotte Sch supported by perforated stones St. During this passage they receive the necessary air for combustion from the vertical flues Lp which conduct preheated all from regenerator v to the mass of chamotte. The hot gases then enter a sole channel l by the ports at the base of the vertical flues k, and thence pass through the regenerative flues t to the main culvert C. The inventor points out that the oven may be connected to a by-product plant during the early part of the distillation in the usual manner, but as the gases evolved became leaner in valuable hydrocarbons, it may be conducted directly into heating flues e at either side of the chamber by the double row of staggered passages s placed between each charge hole m. Figure 6 shows one set of these flues; when the lean gas is to be burned without cleaning, the slide gates Vm are raised. (1,253,445; Assigned to Bernhard Zwillinger of New York City; Jan. 15, 1918.)

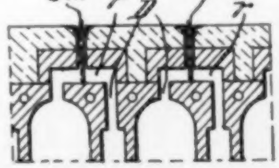


FIG. 6. FLUES

Air Distribution in Regenerative Checkerwork.—J. E. HUBBELL, of Philadelphia, Pa., patents an improvement in coke ovens with vertical heating flues and with regenerators set longitudinally below, designed to preheat the air only. Each unit of the regenerator contains a double sole flue, one for withdrawing the

waste gases during the heating stage, and the other contains an air pipe perforated at intervals along its length which acts as a distributor when cold air is flowing upward. By proper design a very uniform flow of hot air may be admitted into each of the heating flues above the regenerator, there to combine with gas entering through a nearby nozzle. (1,254,-007, Assigned to Louis Wilputte, New Rochelle, N. Y., Jan. 15, 1918.)

Ore Cooling, Moistening and Feeding Table.—A. H. RICHARDS, of Salt Lake City, Utah, patents the device shown in Fig. 7 for converting an intermittent feed from furnace or elevator into a continuous stream. The material, which may be hot, drops through hopper 9 near the center of the rotating plate 10, and is

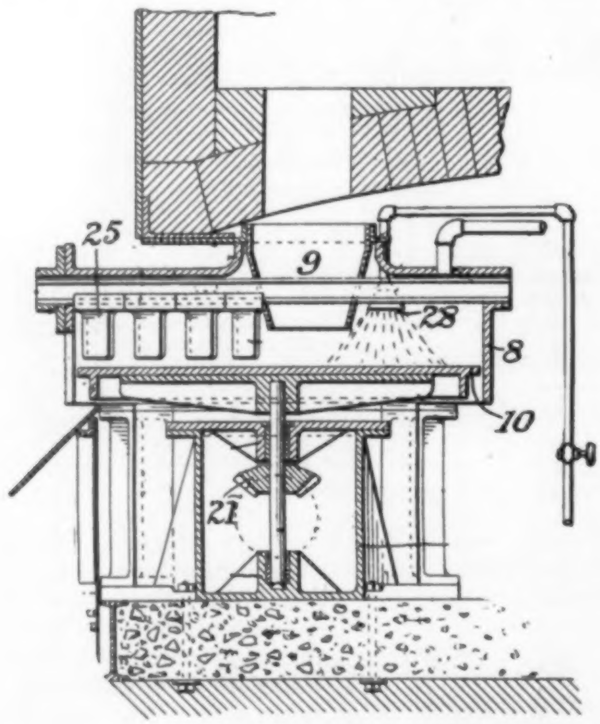


FIG. 7

gradually mixed and worked to the outer edge by the rables 25. Opposite these rabbles is a water spray 28, allowing the ore to moisten and cool one half rotation before reaching the rabble blades. The whole is surrounded by a proper hood 8 and the plate is supported by a shaft passing through the enclosed gear box 21 of sufficient stiffness that rollers under the edge of the horizontal plate are unnecessary. (1,231,-790; Assigned to American Smelting and Refining Co., July 3, 1917.)

Refractories.—R. R. ZELL, of Birmingham, Ala., patents the use of a local mineral product called "siliconite" in the manufacture of refractory brick. Siliconite is finely divided silica, probably formed by weathering of earlier deposits, and contains but small traces of lime and magnesia, and about 2.25 per cent of iron and aluminium oxides. This mineral is crushed and a properly sized product mixed with 5 per cent of aluminium hydrate, 5 per cent of dehydrated gypsum and moistened into a plastic mass with a 10 per cent caustic potash solution. The mass is then wet-pressed, baked at 500 deg. F., and is then ready for the market without further burning. (1,244,275; assigned to Siliconite Refractories Co., Oct, 23, 1917.)

F. M. BECKET, of Niagara Falls, N. Y., patents the use of ordinary or special slags produced in the ferrochromium furnace. These slags are essentially a MgO-Al_2O_3-SiO_2 complex containing lesser percentages of iron and chromium and their oxides. After crushing and sizing, the mass is moistened with water or dilute sodium silicate, shaped in a brick press, and air or furnace-dried at temperatures as required by the contemplated use. The moist mixture may also be tamped in place in the furnace and fired. This refractory has a low coefficient of expansion, a high heat conductivity, high softening point, and very resistant to alkalies and basic slags. (1,244,688; Assigned to Electro Metallurgical Co., Oct. 30, 1917.)

FRED A. JONES, of Lakewood, Ohio, notes that calcined dolomite cannot be used for repairing furnace linings as a substitute for calcined magnesite owing to the fact that the calcium oxide contained in the former tends to air-slack, reducing the lumps to a fine powdery material which will be swept out of the furnace by the draft. He proposes to protect the dolomite from moisture by covering each particle with a layer of slag. He crushes the dolomite to about ¼ inch, and mixes it with 10 per cent by weight of flue dust—essentially fine iron ore, coke, and limestone—when the whole is suitably moistened and calcined at from 2000 to 2500 deg. F. in a rotary kiln. In this manner the CO_2 is driven from the dolomite, and a thin film of impervious material fuses on the outside of each particle. Finely divided materials of the same nature when calcined as noted will produce agglomerated particles of substantially the same properties. (1,251,535; Jan. 1, 1918.)

Electric Furnace Processes for Iron and Steel Manufacture.—ERNE:T HUMBERT, of Welland, Ontario, patents the process of making steel or pig iron by placing scrap irons of various origin in a hot electric furnace together with a predetermined amount of coke and flux. As soon as the lower portion of the solid charge attains incandescence, air is blown into the mass by a pipe, projecting downward through a door, and the end of the pipe adjusted from time to time so as to be kept just above the pool of melting metal. The inventor claims that the air blast removes the impurities very rapidly, and the melting time is largely reduced; the heat ends with refined, hot metal free from iron oxides ready to pour in from ⅜ to ½ the time of the older processes using electric energy only, with a corresponding increase in furnace and electrode capacity and life. (1,242,442, Oct. 9, 1917; and 1,252,443, Jan. 8, 1918.)

SAMUEL MCDONALD, of Alhambra, Cal., patents the process of manufacturing steel in a tilting furnace, containing molten iron or steel, covered with a layer of molten iron ore. Downwardly inclining tuyeres in the rear blow a carbon-laden gas into the mixture at various depths, as the operator wills, by tilting the furnace. The carbon is absorbed by the steel, there to reinforce the reducing action of unabsorbed carbon on the molten oxide laying above and mixed into the metal by the stirring action of the blast. (1,255,191, Feb. 5, 1918.)

Porcelain Pots for the Melting of Optical Glass

THE corrosive action of optical glass-melts and the high temperatures required to fuse them make it necessary to use pots both resistant to the action of the fused mass and sufficiently refractory to withstand the severe heat duty. At the same time it is desirable that the iron content of the pot mixture be so low that practically no contamination of the glass through this source occurs. This is particularly advisable in the fusion of barium glasses which are sensitive to the presence of iron oxide and readily assume a green color which is detrimental for photographic purposes. Since decolorizing is not permissible in making optical glass the importance of pure constituents and of pots as low in iron as possible is obvious. Experience has shown that the commercial pots are not suited for this work. The optical glass laboratory of the Bureau of Standards at Pittsburgh has realized the importance of special pots from the beginning of this work several years ago and has completed a series of experiments with the result that a mixture has been produced which resists even the extremely corrosive action of heavy barium crown glass, which so far has been found to destroy every kind of pot in which attempts have been made to melt it.

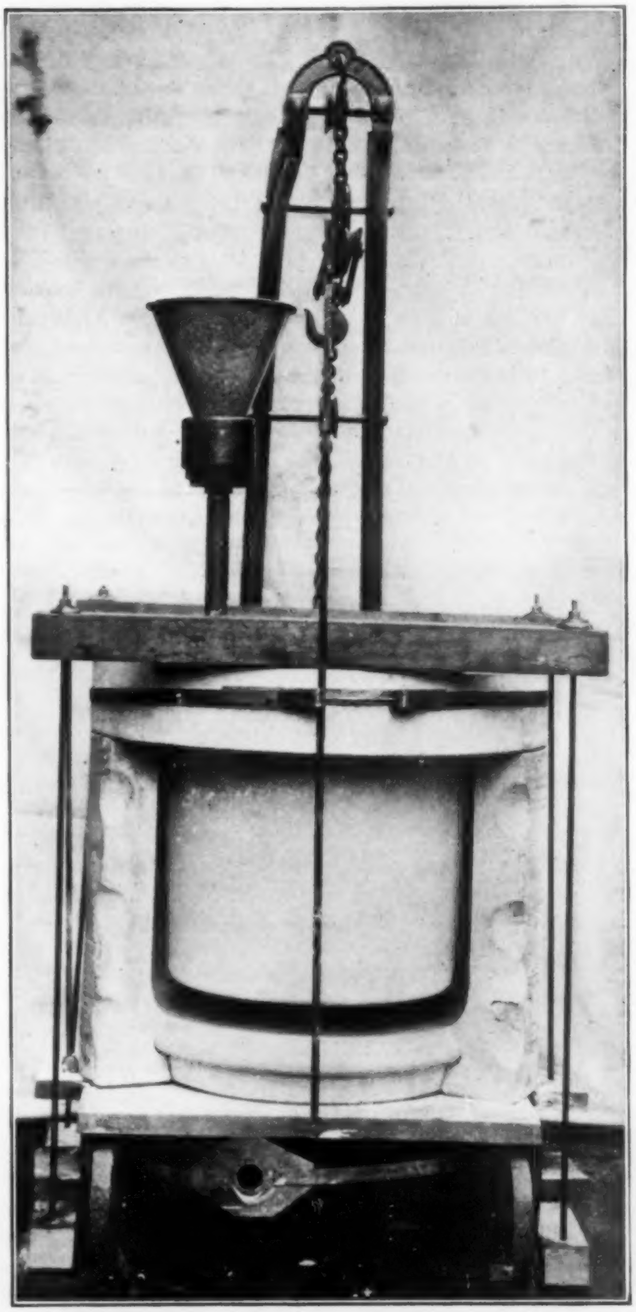
The composition in question is virtually a porcelain and in using the pots it is necessary to carry the temperature to about 1400 deg. C. before they are charged with the glass mixture. This will insure the vitrification of the body and with it the desired dense structure.

The composition which has given the best results is as follows:

	Per cent
White-ware pottery bisque, ground and screened to pass the 10-mesh sieve	35
Pot shell (from used porcelain pots)	10
Feldspar	3
Potters flint	4
Tennessee ball clay	15
Illinois bond clay	5
Georgia kaolin	8
Florida kaolin	8
North Carolina or Maryland kaolin	12
	100

The pottery bisque is the waste unglazed material which is rejected in the manufacture of white tableware. The supply of this bisque is ample for the needs of the pot makers supplying the optical glass manufacturers. For the purpose in question it is necessary to use only the so-called white-ware body and not porcelain, whether it be for table-ware, floor tile or electrical insulators which would not be sufficiently refractory.

At the Pittsburgh laboratory of the Bureau of Standards the production of glass pots by the casting process has also been developed very successfully, thus elminating the use of skilled labor needed in making the pots by the usual building-up method. Here the body constituents, to which about 0.2 per cent of a mixture of sodium silicate and sodium carbonate has been added, are prepared to a thick but still fluid suspension which is poured into suitable plaster molds provided with a core. The plaster absorbs the water very readily and causes the mass to stiffen after about 16 hours when the core can be removed. The mold can be taken apart after about 24 hours. The pots thus made have been found to dry very readily so that in many cases they can be placed in the furnace in from 4 to 6 weeks. This process ordinarily requires from



PLASTER MOLD FOR THE CASTING OF GLASS POTS

3 to 4 months. Cast pots have been made from the following composition:

	Per cent
White-ware pottery bisque, through 10-mesh	48
Tennessee ball clay	15
Illinois bond clay	8
Feldspar	5
Georgia kaolin	7
Florida kaolin	7
North Carolina or Maryland kaolin	10
	100

The cast pots have proved very successful for the melting of optical glass and have been found to be superior to the hand-made ones owing to the uniformity of structure.

A New Drying System for Liquids

AN interesting system for recovering the solid constituents of liquids in a dry, finely powdered form has been developed and is being introduced by Gerald A. Lough of 90 West St., New York. The system is simple and inexpensive and has been found very efficient.

The accompanying photograph shows one of these dryers installed in a tanning extract plant in Tennessee. The process is designated as the "air-blown process" and the equipment consists of a chamber constructed of masonry divided into two compartments, into the first of which the liquid to be evaporated is injected in a fine spray.

A current of hot air, furnished by direct-fire heating from the furnace at the right, is introduced below the spray, rises through it, absorbing its water content, and passes to the second, or dust-settling compartment. The bulk of the solid constituents of the liquid is deposited in the first compartment and the light flocculent particles in the form of fine dust in the second compartment.

A screw conveyor at the bottom of the chamber conveys the dried material from both compartments to a bucket elevator which raises the material to the storage bin at the left. From the bottom of this storage bin the material is bagged.

EQUIPMENT FOR DRYING SOLUTIONS OR SUSPENSIONS

The advantages of the process are claimed to be low first cost and low upkeep, and considerable economy in drying owing in part to the fact that the heat is applied direct to the substance to be dried, and not by transmission through a metal membrane with consequent loss by radiation. The minute subdivision of the atomized fluid permits the heated air to surround each particle and absorb its watery envelope instantly. The liquid is projected into the chamber in such a way as to form a blanket of spray which fills the full transverse area of the chamber, so that to find an exit the hot air must pass through the spray and in consequence give up its heat.

Any product contained in solution, suspension or emulsion may be dried by this means to a fine, dry, flour-like product. Such substances as milk, eggs, malt extract and delicate chemicals may be reduced to their solid constituents by this means at high temperatures without injurious effect. Whole or skimmed milk and eggs dried by this method are completely soluble in cold water.

The accessory apparatus—air heater, air compressor, motors, fan, dust collector and conveyors are all standard equipment, and the dryers are built on the job from plans designed for the customer's particular needs.

Government Powder Plants Completed Ahead of Schedule

Operations in the Government's powder plants near Charleston, W. Va., and Nashville, Tenn., have begun two months ahead of schedule. The Nashville plant started June 4 and Daniel C. Jackling, Director of the United States Government Explosive Plants' Division, reported to Assistant Secretary of War Benedict Crowell that the Charleston plant started June 11. These two plants are beginning with the production of sulphuric and nitric acids, constituent parts in the manufacture of smokeless powder.

The $120,000,000 allotted for the plants is expected to give the Government a smokeless powder production capacity equal to all other American plants combined. The War Department started preparations in the middle of January. A new division was organized, needs of the Army estimated and plans for the two plants were begun. As soon as sites were chosen, it was found necessary to build a new town on each site to house the employees. Approximately 9000 different buildings were erected. A staff of 500 engineers and architects laid out the plans.

Streets were put down and sewered, power plants constructed, and stores and hospitals erected. About 35,000 men worked on the construction of the plants. Probably 30,000 wil be engaged in the actual production of powder.

When the task of building the plants was considered at the War Department last January, it was predicted that the production of powder might begin in August, barring unforeseen delays. Starting of the plants at this time insures their completion and full operation this year, or within less than twelve months of the date on which they were authorized.

Importation of Chrome Ore and Chromite

In pursuance of the general policy of tonnage conservation, the War Trade Board have introduced restrictions upon the importation of chrome ore and chromite from overseas. The sources of home supply are numerous, and are believed to be capable of extensive development. To provide for interim demands, pending the further development of such deposits, imports from Cuba, Guatemala, Newfoundland and Brazil by sea will be permitted, not exceeding 43,500 tons up to March 31, 1919, and from New Caledonia up to 10,000 tons prior to December 31, 1918. Shipments overland or by lake from Canada, overland from Mexico, or as return cargo from European ports when coming from convenient ports and not involving delays in loading, will be permitted. All outstanding licenses for the import of chrome ore and chromite for overseas have been revoked as to shipments made after June 15, 1918.

Book Reviews

THE CHEMICAL ANALYSIS OF IRON, by *A. A. Blair*, 313 pages, J. B. Lippincott Co., Philadelphia, Eighth Edition, 1918. Price $5.00

The eighth edition of this well known work is presented in the same style as former editions. The old cuts have been used throughout with but few exceptions. The methods for the analysis of furnace and other gases have been omitted and a chapter added dealing with the analysis of alloy metals. Although the subject matter has been largely revised and rewritten the book is still open to some criticism.

In the introductory chapter descriptive of apparatus and reagents used in making iron analysis the classification of ammonium bisulphate, NH_4HSO_4, under "alkaline salts" and of barium hydrate under "salts of alkaline earths" will doubtless prove to be misleading to the beginner. In the chapter devoted to the determination of carbon by direct combustion it is disappointing to find no mention of the modern simplified methods in prevalent use and no illustrations of up to date combustion trains.

In the methods given for the determination of manganese mention has been omitted of the widely used titration with sodium arsenite of permanganic acid obtained by oxidation with ammonium persulphate in the presence of silver nitrate. The outline for the determination of nickel by titration with cyanide recommends an ether separation of the iron or the precipitation of nickel with dimethylglyoxime in place of the usual direct and rapid method of adding citric acid to eliminate the interference of iron.

The chapter on the analysis of alloy metals contains some excellent material. It is believed that this volume will be of more interest to the research chemist performing special analyses than to the routine steel works analyst. It contains some good outlines and will prove a valuable addition to reference libraries.

* * *

A TEXT BOOK OF INORGANIC CHEMISTRY. Edited by *J. Newton Friend, D.Sc., Ph.D.* London: Charles Griffin and Company, Ltd.

VOL. I: AN INTRODUCTION TO MODERN INORGANIC CHEMISTRY. By *J. Newton Friend, H. F. V. Little,* and *W. E. S. Turner*. THE INERT GASES (Group O of the Periodic Table). By *H. V. A. Briscoe, D.Sc.* Second Edition, revised; large octavo (15 x 22 cm.), v + 385 pp.; price 10s. 6d. net ($3.50 in U. S. A.).

VOL. IV: ALUMINIUM AND ITS CONGENERS, including the RARE EARTH METALS (Group III of the Periodic Table). By *H. F. V. Little, B.Sc.*, Chief Chemist to Thoruim, Ltd. Large octavo (15 x 22 cm.), xx + 485 pp., price 15s. net ($5.00 in U. S. A.).

VOL. V: CARBON AND ITS ALLIES (Group IV of the Periodic Table). By *R. M. Caven, D.Sc.* Large octavo (15 x 22 cm.), xxi + 468 pp.; price 15s. net ($5.00 in U. S. A.).

VOL. VIII: THE HALOGENS AND THEIR ALLIES (Group VII of the Periodic Table). By *Geoffrey Martin, D.Sc., Ph.D.*, and *Ernest A. Dancaster, B.Sc.* Large octavo (15 x 22 cm.), xviii + 337 pp.; price 10s. 6d. net ($3.50).

The title is something of a misnomer; the work is nearer to being a hand-book or small encyclopedia. It is similar in content to Moissan's "La Chimie Minerale." The plan is unique: each volume from I to IX takes up a successive group of the Periodic Table, thus bringing together in each volume the elements of one chemical family. Volumes II, III, VI, VII and IX are not yet issued.

Volume I is an up-to-date review of inorganic chemistry, followed by a 65 page section on the rare inert gases of Group O. There is not enough detailed explanation for a text-book, but it is a fine reference book, being particularly enriched by numerous foot-note references to the original sources of information. At places, however, the treatment is too scanty, *e.g.*, the vapor pressure of solids is discussed in detail but not that of liquids; specific heats are handled at length, but latent heat of change of state is not even mentioned. One suspects that there may be other omissions of important topics.

Volume IV on boron, aluminium gallium, indium, thallium, scandium, and the rare-earth elements is written in masterly style, particularly the second half devoted to the rare-earths. Aluminium does not lend itself to condensed treatment as well as the other metals mentioned, and in this one instance the subject matter seems scanty and elementary; the other metals are relatively much more thoroughly handled, and in an entirely satisfactory manner which indicates the expert, master of his subject and enthusiastic in its presentation.

Volume V is concerned with carbon, silicon, titanium, tirconium, thorium, germanium, tin and lead. The author was not equal to his task; in fact, he approached it with a dilettante air which spelled failure, he says in his preface "the group contains no element the study of which is quite so fascinating as that of, say, chromium or nitrogen; and, moreover, contains one element tirconium, about which it would be difficult for any chemist to be enthusiastic." Starting with that totally unscientific attitude, an indifferent book followed of necessity; the author might have succeeded better if writing on chronium or nitrogen, but we have a right to doubt even that. The best chapter is that on thorium, and here the author had the assistance of Mr. Little, who wrote the fine treatise on the rare earths in Vol. IV, and who evidently keyed up this chapter to a proper scientific plane. The rest of the book is only "fair to middling."

Volume VIII appeared some time ago, and has already been reviewed in this *Journal*, Feb. 15, 1917, page 233.

The completion of the work as a whole will be a remarkable war-time achievement; the editor and publishers are to be congratulated on their enterprise and on the high average of success attained in the treatises.

* * *

THE THEORY AND PRACTICE OF ORE DRESSING. By *Edward S. Wiard, S.B.* Octova (15 x 23 cm.), viii + 426 pages, 254 illustrations; price $4.00 net. McGraw-Hill Book Company, Inc.: New York.

The scope of the work is narrower than its title. It concerns ore-dressing as applied in the western part of the United States. The treatment is unequal and in many places unsatisfactory. Five pages only to the oil-flotation process is practical exclusion from the book; three pages to electrostatic separation seems pretty scant; eleven pages to magnetic concentration is surely insufficient. These three important methods are all squeezed into one small chapter of twenty pages at the end of the book, whereas one would judge their treatment deserving of several times that space. The Dorr thickener is dismissed with two lines, without any further description; in fact, concentration altogether takes up less than one-fourth of the book, while crushing takes up over one-half. Yet the book has many strong points: crushing is well and thoroughly handled; theory is mixed throughout in a skillful and instructing manner; the practical descriptions are clearly written and well illustrated. With some of its deficiencies made up in a revised edition, it should prove a welcome book to the Western mill-man.

Personal

MR. G. MONTAGUE BUTLER, University of Arizona, has just been appointed Director of the Arizona State Bureau of Mines to fill the vacancy created by the resignation of C. F. Willis. He will continue to serve as Dean of the College of Mines and Engineering, which position he has held for three years. The new Director of the Bureau intends to lay greater emphasis upon geological investigations, and will soon begin to collect the data required for the preparation of a reconnaissance geological map of Arizona.

MR. WILLIAM B. COLVER, chairman of the Federal Trade Commission, who has been in charge of wood pulp and its

products, including paper, has been extended additional authority over the same commodities by the War Industries Board.

ALEX. L. FEILD, formerly assistant metallurgist in the Bureau of Mines, has entered the research department of the National Carbon Co., Inc., in Cleveland, Ohio, and is engaged in general high temperature and physical research. During his service with the Bureau of Mines, Mr. Feild completed the very important investigations on viscosity of iron blast furnace slags.

MR. WALTON C. GRAHAM, manager of the research department of The Great Western Sugar Co., Denver, visited Boston, New York and other Eastern centers following his attendance at the meeting of the Chemical Engineers at Gorham, N. H.

WM. H. HUBBARD, mechanical superintendent of the Balbach Smelting and Refining Company, Newark, N. J., has resigned to take a similar position at the Northport Smelting and Refining Co., Northport, Wash.

M. R. HULL has accepted the position of designing engineer for the Nevada Consolidated Copper Co., at McGill, Nev. Mr. Hull recently returned from the Ural Mountains, Siberia, with orders to proceed with the design of a new copper smelter for the Sissert Mining Co. The mines and smelter have since been seized by the Bolshevik government, however, and the managing director, MR. NORMAN C. STINES, is lost and reported to be a prisoner in Germany. These facts, together with the impossibility of transferring funds, have necessitated the abandonment of the unfinished work.

MR. MILO W. KREJCI has resigned from the position of assistant superintendent of the Boston and Montana Reduction Works of the Anaconda Copper Mining Company, Great Falls, Montana, to enter consultation practice, and will be succeded by J. O. Elton, formerly superintendent of the zinc refinery. Mr. Krejci retires after a service of nearly twenty years, during which time he had superintended nearly every department of the plant. As metallurgist his influence on the development of the 20-foot converter and other Great Falls contributions to the metallurgy of copper was very strong. Recently he has been largely interested in the electrolytic copper and zinc refineries, and has studied the possibilities of making brass in electric furnaces very exhaustively.

CHARLES R. KUZELL has resigned from the staff of the Anaconda Copper Mining Company to assume a position at the United Verde Smeltery at Clarkdale, Ariz. MR. KUZELL was superintendent of reverberatory smelting at the Washoe Reduction Works.

MR. B. F. LAFOLLETTE, who has had charge of the Engineering, Sales and Advertising Departments for the Clarage Fan Company, Kalamazoo, Mich., has resigned to get into Government Service, July 1. He will be located in either Philadelphia or Washington as an engineer with the Requirements Division of the U. S. Shipping Board.

PROF. S. K. LOY, Professor of Chemistry at the University of Wyoming, Laramie, Wyo., has accepted the position of chief chemist with the Midwest Refining Company, Casper, Wyoming.

MR. CHAS. H. MACDOWELL has presented his resignation as a member of the Committee on Fertilizers of the Chemical Alliance, stating that on account of his duties on the War Industries Board he found it impossible to attend the meetings. MR. DEWITT BROWN of Chicago was unanimously elected to succeed Mr. MacDowell.

MR. A. G. MCGREGOR has returned to Warren, Arizona, from a trip to South America, where he is supervising the construction of a new plant for the Cerro de Pasco Copper Corporation.

MR. ALEXANDER ORSCHEFSKY has been made supervisor of the analytical laboratory of the Chrome Plant of the Metal & Thermit Corporation, superseding MR. ABRAHAM L. KONWISER, who resigned.

MR. HERMAN F. SCHOLTZ, assistant chief engineer of the Newport Hydro Carbon Company, and the Newport Chemical Works, Inc., at Carrollville, Wis., has been assigned to active duty as Captain in the Engineer Officers Reserve.

Obituary

MR. C. B. SPRAGUE, chief chemist for the United States Smelting, Refining and Mining Company, died at Salt Lake City, Utah, June 8, from injuries received three days earlier when a speeding automobile in which he was riding struck a fire plug. All the occupants of the machine except the driver also met their death. Mr. Sprague was born in Salt Lake City on Nov. 23, 1875, and attended the University of Utah. He had been employed by the United States Company since 1906, during which time he had paid particular attention to the action of smelter smoke on vegetation and live stock. He was widely known on account of his process of using volatile basic oxides to neutralize sulfuric acid anhydride in smelter gases before bag-housing. This process has been used in the Midvale and Mammoth plants of his own company, and the Murray and Perth Amboy plants of the A. S. & R. Co.

DR. WILLIAM B. PHILLIPS, geologist, died at his home in Houston, Tex., on June 7, aged 61 years. He was born in 1857 at Chapel Hill, N. C., and was educated at the University of North Carolina, where both his father and grandfather had been teachers. Upon his graduation, when he was 20 years old, he went to Saxony, where he studied at the Freiberg School of Mines. For a time after obtaining his degree, he was employed as chemist at the North Carolina Experiment Station. Later, from 1886 to 1888, he taught agricultural chemistry and mineralogy at the University of North Carolina, following in his father's steps. From 1888 to 1892 he practiced as a mining engineer at Birmingham, Ala. During this time he accepted a position in chemistry and metallurgy at the University of Alabama, which he held for two years, then becoming chemist for the Tennessee Coal, Iron and Ry. Co. At this period, he also served on the staff of the *Engineering and Mining Journal.* In 1901 he became director of the University of Texas mineral survey, remaining until 1905, when he again took up private work. In 1909 he was called to take charge of the newly created bureau of economic geology and technology at the university. He resigned this position in 1914 to take the presidency of the Colorado School of Mines, which office, however, he gave up a year later, preferring private practice. He was the author of about 300 scientific and technical articles. Dr. Phillips was a member of the American Institute of Mining Engineers. He was a Mason and a member of the Phi Beta Kappa and Phi Kappa Sigma fraternities.

Current Market Reports

Non-Ferrous Metal Market

Tuesday, June 25.—Prices have a tendency to rise except where the government has fixed set rates.

Aluminium:—The government price is 33c. a pound f.o.b. plant in 50-ton lots, 33.1c. down to 15-ton lots, and 33.2c. in lots down to 1 ton.

Antimony:—Good buying has prevailed and dealers are quoting firm in the range of 13⅛ @ 13⅜c.

Chrome:—Producers have established a schedule on the basis of $1.30 per unit ore.

Copper:—Distribution of copper on the basis of 23½c. to consumers and 24.67½c. to dealers continues by the producers' committee.

Lead:—With the reaching of a price agreement on lead by the producers' committee last week, speculation is eliminated for the duration of the war. The New York basis will be 7.82½c. and East St. Louis, 7.75c.

Manganese:—Variable ton unit scale price, 40 per cent $1.10, 50 per cent $1.20. For full specifications see METALLURGICAL AND CHEMICAL ENGINEERING, page 629, June 15.

Molybdenum:—Quoted at $1.25 per pound for 90% molybdenum sulphide.

Spelter:—Exceptionally strong conditions have ruled the market for prime Western spelter during the past few days and new high prices have been made. Spot New York 8.25 @ 8.37½c. and East St. Louis at 8.20 @ 8.30c.

Tin:—Much interest was manifested by the plan of the government to fix the price of tin. To do this the co-operation of the British, Dutch and Chinese governments will be essential and it is improbable that the latter two will agree; 81c. per lb. for August and September deliveries has been quoted, 90 to 95c. normal. Most of the shipments are coming in via the coast with high freight rates.

Tungsten:—The highest grade material containing no tin, no copper, low manganese and over 70% WO_3 has brought $24.00 per ton unit. Impure material has sold as low as $19.00.

Bismuth	$ 3.50
Cadmium	1.40-1.50
Nickel	.40
Silver	.99½
Platinum, oz.	105.00
Palladium, oz.	135.00
Cobalt	2.50-3.50
Magnesium	1.75-2.00
Quicksilver, California (75 lb.)	125.00
Mexican (75 lb.)	118.00

The Iron and Steel Market

By announcement of June 24 the War Industries Board has continued for another three months, or through September 30, the set prices for pig iron, unfinished steel and finished steel products. Lake Superior iron ore is advanced 45 cents per ton. Various arguments had been presented that there should be advances in one product or another, but the War Industries Board, undoubtedly in collaboration with the Federal Trade Commission, which has complete cost data from all makers, was quite indisposed to make any changes except in the downward direction, and was particularly desirous of avoiding any change that would disturb the present smooth working of things.

The exception made in the case of Lake Superior iron ore was due to the combination of facts that the ore must, beginning June 25, pay advanced rail freights equal to 30 cents per net ton, equal to 33.6 cents per gross ton, although as a matter of fact rates as revised are taken at the nearest ten cent multiple, and that the cost of mining has so advanced, since the expiring ore prices were originally made, November 23, 1916, that the ore producers are in no position to pay the freight advance. It is purely an incident, moreover, that the ore interests were called upon to pay the freight advance in the first place, this being due to the fact that the original freight advance order required that the ore freight advance be paid upon the first haul of the iron ore, while custom has it that Lake Superior iron ore prices are made at Lake Erie dock, and practically all the ore must pay the advance to get to lake water.

The ore advance plus the advanced freight rates on coke, limestone and other supplies, cause an increase in the cost of making a ton of pig iron, at the typical northern furnaces, of more than $1.50. This, however, tends to offset the fact that the authorities at Washington have always considered the pig iron basis, $33, a trifle too high, their original idea having been $30.

Pittsburgh Basis Restored

As noted above, the existing set maximum prices for unfinished and finished steel were continued. One change, however, is made. Bars, shapes and plates, at 2.90c., 3c. and 3.25c., respectively, are set purely on a Pittsburgh basis, the separate Chicago basing point being eliminated. When the original price announcement was made, September 24, 1917, the bar, shape and plate prices were announced as f.o.b. Pittsburgh or Chicago, greatly to the surprise of the trade. Only in times of exceptionally sharp competition in finished steel products, when the market was quite disorganized, have additional basing points been considered or recognized in actual transactions, and for a stable market, such as it is especially desired by all should obtain at this time, the single basing point is virtually a *sine qua non.*

That the great majority of iron and steel producers have been making large profits, and will continue to make large profits, with the set prices continued, goes without saying. The argument that there are some small producers whose costs are exceptionally high has resulted in no action by the War Industries Board, either because the reports to the Federal Trade Commission did not disclose important cases of that description, or from the practical consideration that if a producer's costs are high it is usually because there is an excessive employment of labor or raw materials, the very elements in which there is a scarcity that is restricting to some extent the production of pig iron and steel. The practical thing if such a condition existed would be to release the labor and raw materials that are being wastefully employed, and use them efficiently elsewhere.

Distribution

The system of distribution of pig iron and steel products to the more essential commercial industries is proceeding quite smoothly. The "schedule of purposes entitled to preference treatment" was promulgated by the War Industries Board's resolutions of June 6, referred to in last report. A revised schedule was promised, but is not yet promulgated. The merchant furnaces and steel mills are finding no particular difficulty in interpreting the regulations, and any doubtful cases can readily be referred to Washington.

The regulations are proving not nearly as drastic as they have been painted, for the simple reason that the demand, or requirements, left out represents a relatively small tonnage, generally estimated at lass than 10 per cent of the production. From this it becomes evident that if, after all priorities, allocations and preferences are taken care of there is any pig iron or steel left, it would not require a great deal to produce an actual surplus.

That the war requirements are going to be met fully in all directions is now evident, provided there is no serious curtailment in production from the rate of the past three months. Of all the war requirements the greatest doubt existed in the case of plates for shipbuilding, and yet with shipbuilding speeded up and looking forward to still greater activity, the Director General of Shipbuilding has testified before a congressional committee that he has no uneasiness as to the supply of steel for shipbuilding, his concern being as to accessories, first engines, second boilers and afterwards a variety of minor accessories. All the plans for the war activities contemplate the accumulation, if possible, of surpluses of steel as a measure of safety.

Production

Production of pig iron and steel ingots has been at a slightly greater rate than that of May, when there was a slight improvement, over April, in pig iron, but a slight loss in ingots. The weather on the whole has been a trifle more favorable. July and August are expected to witness considerable shrinkage, but every effort is being made in the industry to curtail the shrinkage that in past summers has been regarded as altogether unavoidable. Labor is scarce, but the scarcity has not interfered greatly with production, and some hopes are entertained that labor conditions may be improved by the regulation now undertaken by the Department of Labor, whereby employers are to avail themselves of the recently established governmental employment agencies and are expected to refrain from paying bonuses or "privateering" in other ways upon the working forces of other employers.

Chemical Market

Heavy Chemicals:—The latter part of the period of the last two weeks has shown considerable lack of activity with a few transactions worthy of note while in matter of price there have developed advances in a few directions with a shading off in others. In most instances however the tendency has been upward.

Bichromate of Soda:—There has been a continued activity in this item on substantial demand. Actual sales of spot material have been made at 27¾c. but up to 28c. was the last reported general trading level. Sizable quantities have been difficult to locate probably because stocks are in very strong hands who have chosen to sit back and await developments of the upward trend.

Soda Ash:—The market has been quiet but actual buyers are reported as having paid 2.90. The general market is asking 3c. to 3.05. Bags from dock were available in a small way at 2.20 but from warehouse, one car was reported as selling at 2.35, which is the generally quoted figure for important business.

Sulphuric Acid:—Quite in line with the general prophecies made at the time of our last report there has developed a shortage in this material accompanied by an appreciation in prices. The 66% brimstone is being offered in tank car lots at 37.50 with quotations from some directions of 40.00. In drums 40.00 and 42.00 are quoted with drums extra. The 60% is being offered in certain directions only for delivery in tank car quanitities at 27.00 and there is very little to be obtained, some producers having already stopped quoting.

Caustic Soda:—Buyers have been showing very little interest and the result has been a decline in price asked on rolling material. The last reported on this type of business was 4c. with material from dock at 4.15 and from warehouse at 4.20 although these prices were considered a little low as the regular traders are quoting from 4.25 to 4.50 on standard brands.

Yellow Prussiate of Soda:—There has been a continued depreciation in price with material rolling to New York available at 61c. and 61½c. Spot prices quoted range from 62 to 64c. Sellers are showing more firmness in light of a renewed inquiry in the last few days.

Glycerine:—The first transaction for a lengthy period was made at 62c., covering about ten cars of dynamite material. Sales of the soap lye, loose, have been noted at 44c. and 46c.

COAL TAR PRODUCTS:—Offerings of most materials have been plentiful but the market has been quiet with a slight falling off in some instances from prices last quoted on a few items. The general tendency however is toward advance also in these materials.

Formaldehyde:—It is understood that restriction has been placed upon this material by the goverament with a setting of a price of 16¼c. works and 16½c. New York. The latest reports disclose offerings of resale material at 17c. in one direction.

Benzol:—This market is fast approaching gasoline prices which brings this fuel again into serious consideration as a substitute. Large producers are willing to accept 23c. in tank car lots and from other directions material in drums is being quoted at 26 and 27c.

Phenol:—The developments have been interesting in spite of the report that the government has purchased 1,000,000 tons for picric acid manufacture. Export licenses for shipment of material to the Far East have been granted and some of the English phenol has been received in this country. In export drums the price was 47c. and for domestic drums 48c. is the general level.

Toluol:—Dye manufacturers are said to be receiving continual releases at the government price of 1.50 for tanks and 1.55 for drums. Resale material is now seldom heard of and then usually in single drum offers.

Hydroquinone:—One of the most favored makes is said to be purchasable at 2.65 through second hands but from 2.75 to 3.00 is the generally quoted range.

Benzoate of Soda:—There has been slight inquiry with a depreciation in price to the generally quoted level of from 3.15 to 3.25 for the toluol product. Manufacturers using the benzol process are quoting from 3.00 to 3.25, depending upon quanitity.

Benzoic Acid:—The acid is showing a firm tone with quotations on the basis of from 3.45 to 3.70 for the acids from both the toluol and benzol processes.

Metatoluolenediamine:—Very little is being offered so far as can be learned and it is reported that the leading producers are sold ahead. Last sales reported were on the basis of from 1.85 to 2.00.

Aniline Oil:—Manufacturers are not meeting the prices asked for resale material and are holding at 27 and 28c.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, JUNE 26, 1918

Acetic anhydride	lb.	1.50	— 1.60
Acetone, drums	lb.	Nominal	
Acid, acetic, 28 per cent	lb.	Nominal	
Acetic, 56 per cent	lb.	Nominal	
Acetic, glacial, 99½ per cent., carboys	lb.	Nominal	
Boric, crystals	lb.	.13½	— .14½
Citric, crystals	lb.	.87	— .88
Hydrochloric, C. P	lb.	Nominal	
Hydrochloric, 20 deg	lb.	.02	— .02½
Hydrochloric, conc., 22 deg	lb.	.02¼	— .03
Hydrofluoric, 30 per cent., in barrels	lb.	.08	— .08½
Lactic, 44 per cent	lb.	.15	— .15½
Lactic, 22 per cent	lb.	.06	— .06½
Molybdic, 85 per cent	lb.	3.85	— .....
Nitric, 36 deg	lb.	Nominal	
Nitric, 42 deg	lb.	.09	— .10
Oxalic, crystals	lb.	.43	— .45
Phosphoric, 47–50 per cent. paste	lb.	.08	— .10
Phosphoric, ref. 50 per cent	lb.	.26	— .....
Picric	lb.	Nominal	
Pyrogallic, resublimed	lb.	3.10	— 3.15
Sulphuric, 60 deg	ton	Nominal	
Sulphuric, 66 deg	ton	37.50	— 40.00
Sulphuric, oleum (Fuming), tank cars	ton	00.00	— 65.00
Tannic, U. S. P., bulk	lb.	1.30	— 1.35
Tartaric, crystals	lb.	.87	— .88
Tungstic, per lb. of W	lb.	1.70	— 1.75
Alcohol, sugar cane, 188 proof	gal.	4.89	— 4.90
Alcohol, wood, 95 per cent	gal.	.90½	— .91
Alcohol, denatured, 180 proof	gal.	.67	— .68
Alum, ammonia lump	lb.	.04	— .04½
Alum, chrome ammonium	lb.	.17½	— .18
Alum, chrome potassium	lb.	.20	— .21
Alum, chrome sodium	lb.	.12½	— .13
Alum, potash lump	lb.	.08½	— .09
Aluminium sulphate, technical	lb.	.02½	— .03
Aluminium sulphate, iron free	lb.	.03¼	— .03½
Ammonia aqua, 26 deg. carboys	lb.	(Fixed Price)	
Ammonia, anhydrous	lb.	Nominal	
Ammonium carbonate	lb.	.15	— .16
Ammonium nitrate	lb.	(Fixed Price)	.15
Ammonium, sulphate domestic	lb.	.07½	— .08
Amyl acetate	gal.	5.15	— 5.25
Arsenic, white	lb.	.09	— .16½
Arsenic, red	lb.	.60	— .70
Barium carbonate, 99 per cent	ton	80.00	— 90.00
Barium carbonate, 97-98 per cent	ton	65.00	— 67.00
Barium chloride	ton	65.00	— 85.00
Barium sulphate (Blanc Fixe, Dry)	lb.	.05	— .05½
Barium nitrate	lb.	.10	— .11
Barium peroxide, basis 70 per cent	lb.	.30	— .32
Bleaching powder, 35 per cent. chlorine	lb.	.01	— .02
Borax, crystals, sacks	lb.	.07½	— .08½
Brimstone, crude	ton	Nominal	
Bromine, technical	lb.	.75	— .....
Calcium, acetate, crude	lb.	Nominal	
Calcium, carbide	lb.	.14	— .16
Calcium chloride, 70-75 per cent., fused, lump	ton	27.50	— 30.00
Calcium peroxide	lb.	1.60	— 1.70
Calcium phosphate	lb.	.34	— .35
Calcium sulphate 98-99 per cent	lb.	.09	— .09½
Carbon bisulphide	lb.	.08½	— .12
Carbon tetrachloride, drums	lb.	.15½	— .16
Carbonyl chloride (phosgene)	lb.	1.10	— 1.50
Caustic potash, 88-92 per cent	lb.	.79	— .82
Caustic soda, 76 per cent	100 lb.	4.00	— 4.25
Chlorine, liquid	lb.	(Fixed Price)	.07½
Cobalt oxide	lb.	1.60	— 1.65
Copperas	lb.	.01¼	— .01½
Copper carbonate	lb.	.30	— .40
Copper cyanide	lb.	.75	— .78
Copper sulphate, 99 per cent., large crystals	lb.	.08½	— .09
Cream of tartar, crystals	lb.	.77	— .80
Epsom salt, bags, U.S.P	lb.	.03¼	— .03½
Formaldehyde, 40 per cent	lb.	.16¼	— .17½
Glauber's salt	100 lb.	1.70	— 1.80
Glycerine, bulk, C. P	lb.	.62	— .65
Iodine, resublimed	lb.	4.25	— 4.30
Iron oxide	lb.	.13	— .15
Lead, acetate, white crystals	lb.	.17	— .18
Lead, arsenate (Paste)	lb.	.15	— .18
Lead nitrate	lb.	Nominal	
Litharge, American	lb.	.10¼	— .10½
Lithium carbonate	lb.	1.50	— 2.00
Manganese dioxide, U. S. P	lb.	.70	— .75
Magnesium carbonate, technical	lb.	.12	— .13
Nickel salt, single	lb.	.14	— .15
Nickel salt, double	lb.	.12	— .14
Phosgene, see Carbonyl chloride			
Phosphorus, red	lb.	1.30	— 1.50
Phosphorus, yellow	lb.	1.00	— 1.25
Potassium bichromate	lb.	.46	— .47
Potassium bromide granular	lb.	1.35	— 1.50
Potassium carbonate calcined, 85-90 per cent	lb.	.40	— .50
Potassium chlorate, crystals	lb.	.38	— .40
Potassium cyanide, 98-99 per cent	lb.	Nominal	
Potassium iodide	lb.	3.75	— 3.80
Potassium muriate 80-85 p. c. basis of 80 p. c.	ton	300.00	— 350.00
Potassium nitrate	lb.	.27	— .31
Potassium permanganate (U. S. P.)	lb.	2.50	— 3.00
Potassium prussiate, red	lb.	2.80	— 2.90
Potassium prussiate, yellow	lb.	1.10	— 1.20
Potassium sulphate, 90-95 p. c. basis 90 p. c.	ton	Nominal	
Rochelle salts	lb.	.44½	— .45
Salammoniac, gray gran	lb.	.22	— .23
Salammoniac, white gran	lb.	.20	— .21
Sal soda	100 lb.	1.35	— 1.40
Salt cake	ton	22.00	— 25.00
Silver cyanide, based on market price of silver	oz.	....	— ....
Silver nitrate	oz.	.62½	— .63
Soda ash, 58 per cent., light, flat (bags)	100 lb.	2.25	— 2.30
Soda ash, 58 per cent., dense, flat	100 lb.	4.00	— 4.10
Sodium acetate	lb.	.27	— .28
Sodium bicarbonate, domestic	lb.	.02¼	— .03
Sodium bicarbonate, English	lb.	....	— ....
Sodium bichromate	lb.	.28	— .28½

Sodium bisulphite, powd	lb.	.12	—	.13
Sodium chlorate	lb.	.24	—	.25
Sodium cyanide	lb.	.39	—	.40
Sodium fluoride, commercial	lb.	.18	—	.19
Sodium hyposulphite	lb.	2.40	—	2.50
Sodium molybdate, per lb. of Mo	lb.	2.50	—	....
Sodium nitrate, 95 per cent	100 lb.	Nominal		
Sodium nitrite	lb.	.28	—	.30
Sodium peroxide	lb.	.35	—	.45
Sodium phosphate	lb.	.04	—	.05
Sodium prussiate, yellow	lb.	.62	—	.65
Sodium silicate, liquid (60 deg.)	lb.	Nominal		
Sodium sulphide, 30 per cent., crystals	lb.	Nominal		
Sodium sulphide, 60 per cent., fused	100 lb.	Nominal		
Sodium sulphite	lb.	Nominal		
Strontium nitrate	lb.	.25	—	.35
Sulphur chloride, drums	lb.	.06	—	.06½
Sulphur dioxide, liquid, in cylinders	lb.	.15	—	.40
Sulphur, flowers, sublimed	100 lb.	4.05	—	4.60
Sulphur, roll	100 lb.	3.70	—	3.85
Sulphur, crude	ton	Nominal		
Tin bichloride, 50 deg	lb.	.27½	—	.28
Tin oxide	lb.	1.00	—	1.25
Zinc carbonate	lb.	.28	—	.30
Zinc chloride	lb.	.15	—	.18
Zinc cyanide	lb.	Nominal		
Zinc dust, 350 mesh	lb.	.14	—	.16
Zinc oxide, American process XX	lb.	.13	—	.14
Zinc sulphate	lb.	.04½	—	.05

Coal Tar Products (Crude)

Benzol, pure, water white	gal.	.23	—	.26
Benzol, 90 per cent	gal.	.25	—	....
Toluol, in tank cars	gal.	(Fixed Price)		1.50
Toluol, for non-military use, in drums	gal.	(Fixed Price)		1.55
Xylol, pure, water white	gal.	.45	—	.55
Solvent naphtha, water white	gal.	.17	—	.22
Solvent naphtha, crude, heavy	gal.	.13	—	.16
Creosote oil, 25 per cent	gal.	.40	—	.55
Dip oil, 20 per cent	gal.	.30	—	.32
Pitch, various grades	ton	8.00	—	20.00
Carbolic acid, crude, 95-97 per cent	lb.	1.05	—	1.10
Carbolic acid, crude, 50 per cent	lb.	.60	—	.65
Carbolic acid, crude, 25 per cent	lb.	.35	—	.38
Cresol, U. S. P	lb.	.18	—	.20

Intermediates, Etc.

Alpha naphthol, crude	lb.	1.00	—	1.10
Alpha naphthol, distilled	lb.	1.60	—	1.70
Alpha naphthylamine	lb.	.60	—	.65
Aniline oil, drums extra	lb.	.25½	—	.26
Aniline salts	lb.	.34	—	.36
Anthracene, 80 per cent	lb.	.50	—	.65
Benzaldehyde (f.f.c.)	lb.	3.65	—	...
Benzidine, base	lb.	1.75	—	2.00
Benzidine, sulphate	lb.	1.40	—	1.50
Benzoic acid U. S. P	lb.	3.45	—	3.70
Benzoate of Soda, U. S. P	lb.	3.00	—	3.25
Benzyl chloride	lb.	2.30	—	2.50
Beta naphthol benzoate	lb.	10.00	—	12.00
Beta naphthol, sublimed	lb.	.85	—	.90
Beta naphthylamine, sublimed	lb.	2.65	—	...
Dichlor benzol	lb.	.15	—	.20
Diethylaniline	lb.	4.50	—	5.00
Dinitro benzol	lb.	.35	—	.40
Dinitrochlorbenzol	lb.	.40	—	.42
Dinitronaphthaline	lb.	.60	—	.70
Dinitrotoluol	lb.	.60	—	.65
Dinitrophenol	lb.	.46	—	.50
Dimethylaniline	lb.	.75	—	.80
Diphenylamine	lb.	1.00	—	1.10
H-acid	lb.	2.30	—	3.00
Metaphenylenediamine	lb.	1.75	—	2.00
Monochlorbenzol	lb.	.17	—	.20
Naphthalene, flake	lb.	.09½	—	.10½
Naphthalene, balls	lb.	.10½	—	.10½
Naphthionic acid, crude	lb.	1.20	—	1.30
Naphthylamin-di-sulphonic acid	lb.	1.00	—	1.10
Nitro naphthaline	lb.	.45	—	.50
Nitro toluol	lb.	.60	—	.65
Ortho-amidophenol	lb.	....	—	....
Ortho-dichlor-benzol	lb.	.15	—	.18
Ortho-toluidine	lb.	1.00	—	1.25
Ortho-nitro-toluol	lb.	.75	—	1.00
Para-amidophenol, base	lb.	4.00	—	4.25
Para-amido-phenol, H. Ch	lb.	4.00	—	5.00
Para-dichlor-benzol	lb.	.12	—	.15
Paranitraniline	lb.	1.60	—	1.70
Para-nitro-toluol	lb.	1.50	—	1.60
Paraphenylenediamine (base)	lb.	3.50	—	4.00
Para toluidine	lb.	2.00	—	2.25
Phthalic acid anhydride	lb.	3.50	—	4.00
Phenol, U. S. P	lb.	.47	—	.48
Resorcin, technical	lb.	5.00	—	6.00
Resorcin, pure	lb.	8.00	—	9.00
Salicylic acid	lb.	.90	—	.95
Salol	lb.	1.90	—	2.00
Sulphanilic acid, crude	lb.	.30	—	.32
Tolidin	lb.	2.50	—	....
Toluidine-mixture	lb.	.85	—	.90

Petroleum Oils

Crude (at the Wells)

Pennsylvania	bbl.	4.00	—	....
Corning, Ohio	bbl.	2.85	—	....
Somerset, Ky	bbl.	2.60	—	....
Wooster, Ohio	bbl.	2.68	—	....
Indiana	bbl.	2.28	—	....
Illinois	bbl.	2.22	—	....
Oklahoma and Kansas	bbl.	2.25	—	....
Caddo, La., light	bbl.	2.25	—	....
Corsicana, Tex., light	bbl.	2.25	—	....
California	bbl.	1.23	—	....
Gulf Coast	bbl.	1.35	—	....

Fuel Oil

New York	gal.	.11	—	....
Pittsburgh	gal.	.07½	—	.10
Oklahoma-Kans	bbl.	1.05	—	2.75
Texas	bbl.	1.85	—	2.35
Los Angeles	bbl.	1.60	—	....
San Francisco	bbl.	1.60	—	....

Gasoline (Wholesale)

New York	gal.	.24	—	....
Boston	gal.	.25	—	....
Pittsburgh	gal.	.28	—	....
Chicago	gal.	.22½	—	....
Oklahoma	gal.	.25	—	....
San Francisco	gal.	.20	—	....

Lubricants

Black, reduced, 29 gravity, 25-30 cold test	gal.	.22	—	.24
Cylinder, light	gal.	.36	—	.38
Cylinder, dark	gal.	.37	—	.38
Paraffine, high viscosity	gal.	.40	—	.41
Paraffine, .903 sp. gr	gal.	.36	—	.38
Paraffine, .885 sp. gr	gal.	.26[illegible]	—	.28

Flotation Oils

(Prices at New York unless otherwise stated)

Pine oil, crude, f. o. b. Florida	gal.	.44	—	....
Pine oil, steam-distilled, sp. gr. 0.925-0.940	gal.	.56	—	.58
Pine oil, destructively distilled	gal.	.49	—	.50
Pine-tar oil, sp. gr., 1.025-1.035	gal.	.35	—	....
Pine-tar oil, double refined, sp. gr. 0.965-0.990	gal.	.40	—	....
Pine-tar oil, ref., light, sp. gr. 0.950, tank cars, f. o. b. works	gal.	.37	—	....
Pine-tar oil, ref., heavy, sp. gr. 1.025, tank cars, f. o. b. works	gal.	.28	—	....
Pine-tar oil, ref., thin, sp. gr. 1.060-1.080	gal.	.32	—	....
Turpentine, crude, sp. gr. 0.870-0.900	gal.	.40	—	....
Hardwood oil, f. o. b. Michigan, sp. gr. 0.960-0.990	gal.	.23	—	....
Hardwood oil, f. o. b. Michigan, sp. gr. 1.06-1.08	gal.	.23	—	....
Wood creosote, ref. f. o. b. Florida	gal.	.31	—	....

Vegetable and Other Oils

China wood oil	lb.	.26	—	.27
Cottonseed oil, crude	lb.	.21	—	.22
Linseed oil, raw, cars	gal.	1.60	—	....
Peanut oil, crude	gal.	1.36	—	1.36½
Rosin oil, first run	gal.	.41	—	.43
Rosin oil, fourth run	gal.	.63	—	....
Soya bean oil, Manchuria	lb.	.18	—	....
Turpentine, spirits	gal.	.75	—	....

Miscellaneous Materials

Barytes, floated, white, foreign	ton	38.00	—	42.00
Barytes, floated, white, domestic	ton	32.00	—	36.00
Beeswax, white, pure	lb.	.62	—	.64
Casein	lb.	.15	—	.20
Chalk, light, precipitated, English	lb.	Nominal		
China clay, imported, lump	ton	17.50	—	36.00
China clay, domestic, lump	ton	12.50	—	20.00
Feldspar	ton	8.00	—	12.00
Fluorspar, gravel, f. o. b. mines	ton	30.00	—	....
Fuller's earth, powdered	100 lb.	1.00	—	1.50
Graphite, flake	lb.	.15	—	.18
Ozokerite, crude,	lb.	Nominal		
Ozokerite, American, refined, white	lb.	Nominal		
Red lead, dry, carloads	lb.	.10	—	.11½
Rosin, 280 lb	bbl.	10.90	—	....
Soapstone	ton	10.00	—	12.50
Talc, American, white	ton	15.00	—	22.00
White lead, dry	lb.	.09½	—	.10½

Refractories, Etc.

(F. O. B. Works)

Chrome brick	net ton	175.00	—	.....
Chrome cement	net ton	75.00	—	.....
Clay brick, 1st quality fireclay	per 1000	50.00	—	55.00
Clay brick, second quality	per 1000	35.00	—	40.00
Magnesite, raw	ton	30.00	—	35.00
Magnesite, calcined, powdered	ton	50.00	—	65.00
Magnesite, dead burned	net ton	50.00	—	60.00
Magnesia brick, 9x4½x2½	net ton	110.00	—	125.00
Silica brick	per 1000	50.00	—	60.00

Ferroalloys

Ferrocarbontitanium, 15-18 per cent., carloads, f. o. b. Niagara Falls, N. Y	ton	......	—	....
Ferrocerium	lb.	15.00	—	20.00
Ferrochromium, per lb. of Cr	lb.	......	—	....
Ferromanganese, domestic, 70 per cent. basis	ton	250.00	—	....
Ferromanganese, English	ton	325.00	—	....
Ferromolybdenum, per lb. of Mo	lb.	5.00	—	....
Ferrosilicon, 75 per cent., f. o. b., N. Y	ton	....	—	....
Ferrosilicon, 50 per cent., carloads, del., Pittsburgh	ton	180.00	—	190.00
Ferrosilicon, 50 per cent., contract	ton	160.00	—	170.00
Ferrotungsten, 75-85 per cent., f. o. b., Pittsburgh	lb.	2.35	—	2.40
Ferrouranium, f. o. b. works, per lb. of U	lb.	7.50	—	....
Ferrovanadium, f. o. b. works	lb.	....	—	....

Ores and Semi-finished Products

Antimony ore, per unit		Nominal		
Chrome ore, 45 per cent. minimum, f.o.b. Cal., per unit	ton	1.50	—	1.55
Chrome ore, 43 per cent. and over, New York, per unit	ton	....	—	....
Manganese ore, 48 per cent. and over, per unit	ton	1.20	—	....
Manganese ore, chemical	ton	80.00	—	100.00
Molybdenite, per lb. of MoS_2	lb.	1.25	—	....
Tungsten, Scheelite, per unit of WO_3	ton	24.00	—	....
Tungsten, Wolframite, per unit of WO_3	ton	24.00	—	....
Uranium oxide, 96%	lb.	3.25	—	3.60
Vanadium pentoxide, 99%	lb.	10.50	—	....
Pyrites, foreign	unit	.17	—	.17½
Pyrites' domestic	unit	.28	—	.30

INDUSTRIAL NEWS

Plant Construction—Catalogs—New Publications

Construction and Operation

Alabama

ASHLAND—The Empire Graphite Co. will rebuild its plant recently destroyed by fire with a loss of $50,000.

BIRMINGHAM—The Ingalls Iron Works, Avenue D and Seventh St., will build a steel frame addition to its plant. Estimated cost, $9,300.

Arkansas

FORT SMITH—The Arkansas Mining & Mercantile Co. will build a 200-ton concentration plant at its zinc and lead mine located between Boone and Marion Counties. Estimated cost, $60,000. The company is in the market for drills, sludge and slime tables, engines, boilers, compressors, ore crushers, track, cars, belts and mill hardware. F. A. Handlen, president and manager.

ROGERS—The Lenk Pat. Mining Co. Joplin, Mo., will build a concentration and stamp mill here and is in the market for crushers, rollers, sludge and slime tables, engines, boilers, etc. Estimated cost, $100,000. P. Cleburn Quinn, 530 Main St., Joplin, Mo., superintendent.

ZINC—The Consolidated Zinc Mines Co., Dallas, Tex., will build a 400-ton concentration plant here. The company is in the market for sludge and slime tables, ore cars, scales, etc. Estimated cost, $70,000. N. W. Palmer, Muskogee, Okla., superintendent.

Colorado

LEADVILLE—The Royal Tiger Mining & Milling Co. will build a 300-ton milling plant on its property in Swan Valley, north of Breckenridge.

Connecticut

BRIDGEPORT—Until July 11th, by Sewer and Paving Commission, building sewage disposal plant on Bostwick Ave.

NEW HAVEN—The United States War Department, Washington, D. C., will build a plant for the production of toluol from gas, to be located near the works of the New Haven Gas Co., on East Chapel St. Estimated cost, $110,000. H. Koppers Co., Union Arcade, Pittsburgh, Pa., has charge of the work.

Illinois

PEORIA—The Peoria Tractor Co., 1100 West, Washington St., has purchased a site on East Washington St. and will build a factory for the manufacture of machines.

Indiana

WHITING—The city plans to build a water filtration plant of 4,000,000 gal. daily capacity. Estimated cost, $130,000. S. A. Greely, 64 West Randolph, Chicago, Ill., engineer.

Iowa

CEDAR RAPIDS—The La Plant Choate Steel Co., c/o E. W. La Plant, 1801 Bever Ave., has awarded the contract for the construction of a brick and mill construction factory, to Loomis Bros., Perpetual Building.

OTTUMWA JUNCTION—The Chicago, Milwaukee & St. Paul Ry., C. F. Loweth, chief engineer, Railway Exchange Building, Chicago, Ill., will build pumping station and filter plant of 70,000 gal. capacity, including pipe line and tank, which is a part of the new terminal facilities to cost, $500,000.

Kansas

BADGER—The Badger Mining & Development Co., 103 Miners Bank Building, Joplin, Mo., will build a 150-ton concentration plant on their 210 acre lease here and are in the market for sludge and slime tables, ore crushers, etc. Estimated cost, $60,000. T. E. Forester, superintendent.

BAXTER SPRINGS—The Big Lead Mining Co., Muskogee, Okla., will build a concentration plant here. Estimated cost, $75,000. J. E. Hoshal, superintendent.

BAXTER SPRINGS—The Cortez Mining Co., Jefferson City, Mo., will build a 250-ton concentration mill and a 125-H. P. power plant requiring sludge and slime tables, motors and crushers. Estimated cost, $68,000.

BAXTER SPRINGS—The Quaker Valley Mining Co. will build a concentration plant requiring crushers, engine, oilers and sludge tables. Estimated cost, $50,000. W. W. Wakeman, superintendent.

NEWTON—The city plans to build sewage disposal plant consisting of pump house and pumps, imhoff tank, sprinkling filter, secondary settling tank and sludge filter, with connection sewers, manholes, etc. Black & Veatch, 502 Interstate Building, Kansas City, Mo., engineers.

Kentucky

LEXINGTON—The Lexington Roller Mills Co., 133-135 Broadway, has awarded the contract for the construction of a two-story brick addition to its corn and flour mill, to Combs Lumber Co., 439 East Main St. Estimated cost, $10,000.

LOUISVILLE—The Magic Keller Soap Co., 2745 Stolkers St., has awarded the contract for the construction of a 4-story brick factory, to the National Concrete Construction Co., Board of Trade Building. Estimated cost, $50,000.

Maryland

FORT McHENRY—The Cantonment Division, War Department, Washington, D. C., will build a chemical laboratory at the general hospital here. About $152,000, cost plus percentage.

INDIAN HEAD—The Bureau of Yards and Docks, Navy Department, Washington, D. C., will remodel its chemical laboratory here. Estimated cost, $20,000.

Michigan

DETROIT—The J. E. Bolles Iron & Wire Works, Milwaukee Ave., between Hastings and Crystal Sts., has awarded the contract for the construction of a one-story, brick addition to its factory to Walbridge-Aldinger Co., 2356 Penobscot Building.

GRAND RAPIDS—The Rudy Furnace Co. has awarded the contract for the construction of another plant here to Byers Construction Co., Kalamazoo. Estimated cost, $50,000.

Missouri

JOPLIN—The Kirkwood Mining Co., Room 12, Cunningham Building, will build a 150-ton concentration plant, requiring sludge tables, motors and crushers. Estimated cost $40,000. S. A. Smith, general manager.

JOPLIN—The Klein & Stern Investment Co., Frisco Building, will build a 150-ton concentration plant requiring sludge and slime tables, crushers, belts, engines, etc. Estimated cost, $35,000.

JOPLIN—The Miami Yellville Mining Co., West Seventh St., will remodel its concentration plant and install new machinery. Estimated cost, $25,000. J. Taylor, c/o Liberty Theater, superintendent.

JOPLIN—The Muskogee Lead & Zinc Co. will build a 300-ton concentration mill requiring sludge tables conveyors, air compressors. Estimated cost, $58,000. E. C. Beatty, Springfield, manager.

JOPLIN—The New Carolyn Metal Co. has purchased the Neosho Granby Metal Co., and will build a new 300-ton mill and increase the capacity of the present 150-ton mill to 300-tons. The company is in the market for sludge tables, slime tables, crushers, air compressors, engines and boilers. Estimated cost, $100,000. Nels Darling, Oklahoma City, Okla., superintend.

JOPLIN—Pfaeffle & Keller, West Fourth St., will build 150-ton concentration plant at its mine. Estimated cost, $25,000. W. Pfaeffle, Fourth and North Pearl Sts., superintendent.

JOPLIN—Plachard & Clear Mining Co., Cunningham Building, will remodel its concentration plant at its mine and also install new machinery. Estimated cost, $26,000. Fletcher Clear, Joplin, superintendent.

KANSAS CITY—The Jensen-Salsberry Laboratories, 1320 Main St., will build a 3-story, 28 x 128 ft., reinforced concrete and brick laboratory. E. O. Brostrom, 212 Reliance Building, architect.

Nebraska

LINCOLN—The State Board of Control, J. S. Dales, secretary, will build a 3-story, 101 x 102 ft. laboratory building at Forty-second St. and Dewey Ave. Estimated cost, $120,000. John Latenser & Sons, 626 Bee Building, architects.

New Jersey

CAMDEN—The Warren & Webster Co., Point and Pearl Sts., will build a 2-story, 43 x 71 ft., reinforced concrete, brick and steel factory, for the manufacture of heating systems and ventilating specialities, on north side of Pearl St., between Delaware Ave. and Point St. Ballinger & Perrot, Seventeenth and Arch Sts., Philadelphia, Pa., architects.

JERSEY CITY—The Brady Brass Co., Fourteenth St., has awarded the contract for the construction of a 4-story, reinforced concrete and brick factory building, to J. Mitchell, 76 Montgomery St. Estimated cost, $25,000.

IRVINGTON—The Day-Elder Motors Co., 161 Ogden St., Newark, has awarded the contract for the construction of a brick and mill construction factory here to Becker Construction Co., 361 Grove St., Newark.

NEWARK—The Mennen Gerhardt Chemical Co., 40 Spring St., has awarded the contract for the construction of a brick addition to its plant on Central Ave., to H. M. Doremus & Co., 36 Orange Ave. Estimated cost, $48,000. Noted June 15.

TRENTON—John E. Thorpp's Sons Co., Lewis St., will build a foundry and iron plant along the Delaware River. Estimated cost, $100,000. J. Osborne Hunt, 114 North Montgomery St., architect.

New York

BROOKLYN—The Gotham Can Co., 60 Eagle St., has awarded the contract for the construction of a 3-story, 60 x 100 ft. factory, to W. R. McGarry Co., 306 Freeman St. Estimated cost, $45,000.

BUFFALO—The Donner Steel Co., 475 Abbott Road, will build a reinforced concrete, brick and steel coke oven plant containing 180 ovens. Estimated cost, $3,000,000. H. Koppers Co., Pittsburgh, Pa., engineers.

BUFFALO—The National Aniline & Chemical Co., Abbott Road, will build a 6-story, 150 x 250 ft., reinforced concrete, brick and steel factory addition. Estimated cost, $300,000. T. H. McKaig Co., c/o of Owners, engineers.

BUFFALO—The Strong Steel Co., 33 Norris St., will build a 1-story, 80 x 300 ft., concrete, brick and steel foundry and machine shop. Estimated cost, $75,000.

LONG ISLAND CITY—The Meurer Steel Barrel Co., 575 Flushing Ave., has awarded the contract for the construction of a 1- and 2-story, 200 x 255 ft., factory to Peter Guthy, 926 Broadway, Brooklyn. Estimated cost, $75,000.

LONG ISLAND CITY—The Racich Asbestos Co., 609 West Twenty-second St., New York City, will build a 3-story, 90 x 115 ft., brick factory on Harris Ave. and Hancock St. Estimated cost, $60,000. E. A. Richardson, 100 Amity St., architect.

NIAGARA FALLS—The Hydraulic Power Co., Hydraulic Canal, has awarded the contract for the construction of the substructure for a 1-story, 100 x 300 ft. hydro electric plant at Canal Basin, to Dock Construction Co., 95 River St., Hoboken, N. J. Estimated cost, $1,000,000.

NIAGARA FALLS—The United States Light & Heat Co., manufacturer of heating specialties, 3215 Highland Ave., will build a 1-story, 150x300 ft., reinforced concrete, brick and steel factory. Estimated cost, $75,000. Mills, Rhines, Bellman & Nordoff, Ohio Building, Toledo, O., architects.

RED HOUSE—A. B. Smith Co., White Building, Buffalo, will build a 2-story, 100 x 250 ft., brick chemical plant here. Estimated cost, $35,000.

ROCHESTER—The Bridgeford Tool & Machine Co., Winton Road, will build a 3-story, 60 x 200 ft. machine shop. Estimated cost, $50,000. R. S. Byers, Chamber of Commerce Building, architect.

ROCHESTER—The Monroe Iron, Metal & Cooperage Co., 510 State St., has awarded the contract for the construction of a 2-story, 50 x 100 ft. plant, to William Kenny, 86 Frost Ave. Estimated cost, $23,000.

ROCHESTER—The Wollensak Optical Co., 1415 Clinton Ave., N., will build a 2-story, 150 x 200 ft., reinforced concrete,

brick and steel optical plant. Estimated cost, $75,000.

SYRACUSE—The Crucible Steel Co., 104 Magnolia St., has awarded the contract for the construction of a 1-story, 90 x 125 ft., concrete, brick and steel machine shop, to J. D. Taylor Co., 115 South Salina St. Estimated cost, $40,000.

UTICA—The United States War Department, Washington, D. C., will build a plant on the east side of Snipe St. near the plant of the Utica Gas & Electric Co., for the production of toluol from gas. Estimated cost, $65,000.

Ohio

CARTHAGE—The Pollak Steel Co., Seventy-first St., Cincinnati, will build a 1-story press shop as an addition to its plant here. Estimated cost, $8,000.

CINCINNATI—The Peerless Foundry Co., Eleventh and High Sts., has awarded the contract for the construction of a 1-story, 120 x 200 ft. and 60 x 120 ft. grey iron foundry, fireproof construction, on Elmwood place, to M. Marcus Building Co., 2023 Reading Road. Etimated cost, $75,000. Noted May 15.

CLEVELAND—The Cleveland Smelting & Refining Co., 357 Leader-News Building, will build a plant for smelting old and new metals. Estimated cost, $200,000. E. A. Stotter, superintendent.

CLEVELAND—The Electrical Steel & Forge Co., Grant Ave., and Belt Line Railway, will build a 1-story, 60 x 600 and 20 x 200 ft. concrete, brick and steel rolling mill and warehouse. Estimated cost, $100,000.

ELIZABETHTOWN—The Nitrate Division, Bureau of Ordnance, War Department, Washington, D. C., has awarded the contract for the construction of a plant for the manufacture of nitrate, to the Air Nitrate Corporation, 360 Madison Ave., New York City. Cost will run into millions.

FINDLAY—The Grant Motor Car Corporation, Colt and Kirley Aves., Cleveland, has awarded the contract for the construction of six factory buildings, brick and concrete, to W. I. Thompson & Son Co., 6110 Euclid Ave., Cleveland. Estimated cost, $100,000.

FINDLAY—The Giant Tire & Rubber Co., Western Ave., will rebuild its plant which was recently destroyed by fire.

LORAIN—The W. S. Automatic Co. will build a 2-story, 120-160 ft. addition to its plant. Estimated cost, $100,000.

TOLEDO—The Nitrate Division, Bureau of Ordnance, War Department, Washington, D. C., has awarded the contract for the construction of nitrate plant No. 3, to the Air Nitrate Corporation, 360 Madison Ave., New York City. Cost will run into millions.

Oklahoma

DOUTHAT—The Century Mining Co. will build a 150-ton concentration plant. Estimated cost, $60,000.

DOUTHAT—The Douthat Miami Mining Co., Carden, will build a 200-ton concentration plant, requiring engines, boilers, sludge and slime tables, crushers, ore cars and bins. Estimated cost, $60,000. Charles Douthat, superintendent.

HOCKERVILLE—The Bucksho Mining Co., 321 Hancock Building, Miami, will build a 150-ton concentration plant, requiring sludge tables, slime tables, engine and boilers. Estimated cost, $60,000. Robert E. Brooke, superintendent.

HOCKERVILLE — The Lucky Jennie Mining Co. will build a concentration plant and install machinery including engines, boilers, etc. Estimated cost, $60,000. W. F. Cooper, superintendent.

LEADVILLE—The Waxahachie Mining Co., Oklahoma City, will build a 150-ton concentration plant requiring sludge tables, crushers and conveyors. Estimated cost, $60,000. J. Hare, manager.

MIAMI—The Aurora Mining Co., will build a concentration plant, requiring sludge and slime tables, ore crushers motors, air compressors, belts, conveyors. Estimated cost, $60,000. John W. Hale, superintendent.

MIAMI—The Indian Chief Mining Co. will build a 300-ton concentration plant. The company is in the market for sludge and slime tables, crushers, boilers, engines and track cars. Estimated cost, $75,000. John L. Sullivan, Miami, superintendent.

MIAMI—The Miami Mining Co., 8 A St., S. E., will build four 400-ton concentration plants. Estimated cost, $250,000. J. P. McNaughton, superintendent. The company is in the market for sludge and slime tables, crushers, engines, boilers, air compressors and scales.

OKLAHOMA CITY—The Midland Motor Car & Truck Co., 519 Mercantile Building, will build a 80 x 500 ft. factory for the manufacture of airplanes.

PEORIA—The Nebo Lead & Zinc Co. will build a 150-ton concentration plant, requiring slime and sludge tables, air compressors, engines, boilers, tracks, ore cars, belts, conveyors and ore crushers. Estimated cost, $60,000. R. C. Crosien, superintendent.

PEORIA—The Palative Lead & Zinc Mining Co. Miami, will build a 250-ton concentration plant requiring jigs, sludge and slime tables, ore crushers, etc.

PICHER—The Commonwealth Zinc & Lead Co., Miami, will rebuild its mill here, destroyed by fire, and install machinery including drills, sludge and slime tables, ore cars and conveyors, crushers, belts, engines and boilers. Estimated cost, $100,000. L. N. Dana, Joplin, Mo., superintendent.

PICHER—The Miami Lead & Zinc Co., Miami, will build a 200-ton concentration plant and install machinery including hardware, sludge and slime tables, and lumber for mill. Estimated cost, $65,000.

POTEAU—The Poteau Window & Dry Plate Glass Co. will construct four buildings for the manufacture of glass for windows and photographic dry plates.

Pennsylvania

CONNELLSVILLE — The McCairns Foundry Co. has awarded the contract for the construction of a 60 x 65 ft., brick and steel addition to its plant on the west side, to Cooper Patterson. Estimated cost, $15,000.

MIDLAND — The Pittsburgh Crucible Steel Co., Empire Building, Pittsburgh, will build a mill here. W. G. O'Malley, manager.

PHILADELPHIA—The Barrett Manufacturing Co., Margaret and Bermuda Sts., has awarded the contract for the construction of a 1-story, 60 x 65 ft., concrete, brick and steel addition to its factory for the manufacture of coal tar products, to A. Raymond Raff Co., 1635 West Thompson St. Estimated cost, $15,000.

PHILADELPHIA—The Gosa-Brockman Co., 12 North Fifth St., has awarded the contract for the construction of a 1-story, 60 x 62 brick and steel machine shop on Eleventh and Schiller Sts., with a wing 12 x 20 ft. to F. L. Hoover & Sons Co., 1023 Cherry St. Estimated cost, $13,000.

PHILADELPHIA — The Nitrogenous Chemical Co., 101 West End Trust Building, has awarded the contract for the construction of a 2-story, concrete and brick factory addition at Thirty-seventh and Tasker Sts., to Ernest Roth, 1541 Cabot St. Estimated cost, $50,000.

PHILADELPHIA—The Super Glass Co., 3400 Disston St., will build a 1-story, 25 x 25 ft. brick factory addition at Howell St. and State Road.

RUTHERFORD—The Reading Railway Co., Atlantic and Arkansas Sts., Reading, has awarded the contract for the construction of a 1-story, 50 x 175 ft., brick machine shop here, to A. Woelfel, Lancaster. Estimated cost, $50,000.

Tennessee

NASHVILLE—The Southern Machine & Foundry Co., 213 Fourth Ave., S., will rebuild its plant lately destroyed by fire.

Texas

SAN ANGELO—The Great Republic Tire & Rubber Co. will build a factory here. Estimated cost, $100,000.

WACO—The Boone Tire & Rubber Co., c/o Chamber of Commerce, will build a factory for the manufacture of automobile tires and other rubber products. Roy E. Lane, Waco, architects.

WICHITA FALLS—Sunshine State Oil Co. has awarded the contract for the construction of an oil refinery, to the United Iron Works, Mill and Prospect Sts., Springfield, Mo. Estimated cost, $150,000.

Washington

SEATTLE—The Gulowsen-Grei Engine Co., Alaska Building, has awarded the contract for the construction of a 2-story, 174 x 300 ft. factory on Salmon Bay Dock, to consist of a 174 x 300 ft machinery and office building, 94 x 132 ft. foundry and 30 x 90 ft. pattern shop to M. Arveson, Downs Block. Estimated cost, $126,500.

West Virginia

MOUNDSVILLE — The United States Smelting Corporation, Frisco Building, Joplin, Mo., will build a plant for smelting ore here. Estimated cost, $1,000,000. C. E. Marshall, Joplin, manager.

Wisconsin

MILWAUKEE—The National Brake & Electric Co., Belleview and Cambridge Sts., will build a 1-story, 40 x 130 ft., concrete and brick foundry. Estimated cost, $22,000. Noted June 15.

MILWAUKEE—The Cutler-Hammer Co., St. Paul Ave., west of Thirteenth St., will build a plant. Estimated cost, $6,000.

MILWAUKEE — The Globe Seamless Steel Tube Co., Colby-Abbot Building, will build a 1-story, 130 x 170 and 130 x 250 ft. brick and steel plant.

SHAWANE—The Wolfe River Paper & Fiber Co. will build a 2-story, 16x50 ft., addition to its mill. Estimated cost, $5,000. L. A. DeGuere, Grand Rapids, engineer.

SHEBOYGAN — The Jenkins Machine Co., 315 North Eighth St., will build an addition to its plant. The company recently obtained a large war order.

WEST ALLIS—The Universal Machinery Co., 785 Thirtieth St., Milwaukee, will build a 1-story, 150 x 480 ft. machine shop here. F. E. Gray and Val. A. Siebert, 86 Michigan St., Milwaukee, architects.

British Columbia

BEAVER COVE—The Beaver Cove Lumber & Pulp Co., London Building, Vancouver, will build lumber and pulp mills here. Estimated cost, $250,000. W. H. White, manager.

VANCOUVER — The Department of Mines, Dominion Government, Ottawa, Ont., will build ore testing plant. Estimated cost, $60,000.

Manitoba

WINNIPEG — The Hygiene Products, Ltd., 607 Young St., will build a plant here.

Nova Scotia

HALIFAX—Robinson Co., Ltd., has awarded the contract for the construction of a brick and reinforced concrete garage and repair shop, to Maritime Construction Co., Queens Building. Estimated cost, $50,000.

STELLARTON—W. P. McNeil will build a munition plant here. Estimated cost, $60,000.

SYDNEY—The Dominion Iron & Steel Corporation, 112 St. James St., Montreal, Que., will build a steel rolling mill. Estimated cost, $5,000,000.

Ontario

BRAMPTON—The Hercules Rubber Co. will build a plant for the manufacture of automobile tires, etc. Estimated cost, $60,000. Thomas Thauburn is interested.

TORONTO—The Gutta Percha Rubber Co., Ltd., 4 Yonge St., will build a factory on O'Hara Ave.

TORONTO—The National Iron Works, Ltd., foot of Cherry St., will build a 1-story, steel and galvanized iron addition to its factory. Estimated cost, $15,000.

TORONTO—The Universal Tool Steel Co., 159 Dufferin St., will build a 1-story, brick addition to its plant, mill construction. Estimated cost, $45,000. G. C. Briggs, 27 Wellington St., E., architect.

WELLAND—The Metals Chemical Co. has awarded the contract for the construction of a plant for the manufacture of arsenic to the Burns Cement-Gun Construction Co., Toronto.

WINDSOR—The Driver Harris Co., Harrison, N. J., has purchased a site here and will build a plant for the manufacture of all kinds of alloys. Estimated cost, $60,000.

Quebec

COTE ST. PAUL—The Crane Co., Ltd., Montreal, will build a plant for the manufacture of valves, fillings and a full line of plumbers' supplies, on St. Patrick St. Estimated cost, $400,000. R. T. Crane, Jr., president.

MONTREAL—P. Lyall & Sons Construction Co., Ltd., 701 Transportation Building, will build a 1-story, brick forge shop, on Notre Dame St., E. Estimated cost, $40,000.

TIMISKAMING—The Riordon Pulp & Paper Co., 355 Beaver Hall Square, Montreal, will build a sulphite mill and power house here.

Industrial Notes

THE WILPUTTE COKE OVEN CORPORATION announces the removal of its offices and engineering department to the Winfield Building, No. 469 Fifth Avenue, corner of 40th Street, New York.

THE BOOTH-HALL COMPANY, 565 West Washington Boulevard, Chicago, Ill., has made arrangements with the Bradford-Ackerman Corporation, 30 East 42d Street, New York, to take entire charge of sales in the eastern section of the United States.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburgh, Pa., has purchased the property, business and good will of the Krantz Manufacturing Company, Inc., Brooklyn, N. Y., manufacturers of safety and semi-safety electrical and other devices, such as auto-lock switches, distribution panels, switchboards, floor boxes, bushings, etc. The Supply Department of the Westinghouse Electric & Manufacturing Company will act as exclusive sales agent for the products of the Krantz Manufacturing Company, whose business will be continued under its present name. Mr. H. G. Hoke, of the Westinghouse Electric & Manufacturing Company, will represent the Supply Department at the Krantz Factory.

HAMILTON & HANSELL, INC., New York, have recently contracted with the Government for two Rennerfelt electric furnaces which will be installed at the United States Mint in Philadelphia, for melting bronze and cupro-nickel for coins. These furnaces are of the latest design, equipped with overlip tilting and automatic side electrode feeding mechanism. The 1000-lb. Rennerfelt furnace with its electrical equipment, installed some time ago, is to be shipped to the Pacific coast and installed at the Mint in San Francisco.

THE ALGOMA STEEL CORPORATION, of Sault Ste Marie, Ontario, is going to enlarge its by-product coke oven plant and a contract for an additional battery of twenty-five Wilputte ovens has just been let to the Wilputte Coke Oven Corporation, of New York City, making fifty new ovens now in process of construction. The two new batteries will probably be ready for operation this year.

THE R. U. V. COMPANY, INC., announce that they have moved their New York office to 120 Broadway.

THE WHEELER CONDENSER & ENGINEERING Co., Carteret, N. J., has, under agreement with the Sugar Apparatus Manufacturing Co., acquired the exclusive right to manufacture and sell evaporating apparatus under the patents of S. Morris Lillie, president of that company. The advice of Mr. Lillie is to be at all times at the command of the Wheeler Condenser & Engineering Co. and at the same time Mr. Lillie will have the coöperation of the entire engineering, sales shop and erecting organization of the Wheeler Company.

THE ZAREMBA COMPANY announce the removal of their offices to Niagara Life Insurance Building, Room 1506, corner Franklin and Mohawk Streets, Buffalo, N. Y.

THE MEXICAN PROMOTING AND INVESTING CORPORATION have moved their New York office to 52 Broadway, Room 622.

THE ELECTRON CHEMICAL COMPANY are now located in Room 1403, 347 Madison Avenue, New York.

PARR TERMINALS Co., Wilfred N. Ball, Engineer, 325 First National Bank, Oakland, Calif., wants catalogs and other data from manufacturers of materials or equipment used in the construction of piers, warehouses, industrial buildings, belt line railway and street work and cargo handling equipment, coal bunkering and handling equipment, floating dry dock and marine railway equipment and general ship yard machinery and equipment.

Government Contracts Awarded—Contracts recently awarded by Ordnance Department of U. S. Army:

Material	*Firm*
Fused calcium chloride.	Semet-Solvay Co., Syracuse, N. Y.
Lily white wax.	Stevenson Bros. & Co., Philadelphia, Pa.
Oxygen gas and cylinder.	Burdette Oxygen Co., Cambridge, Mass.
Soda ash.	Mathieson Alkali Works, Providence, R. I.
Sulphate of ammonia.	Illinois Steel Co., Gary, Ind.
Benzol (packed for shipment abroad).	Barrett Co., New York, N. Y.
Smoke bomb outfits (pole type).	Gillespie Manufacturing Corporation, Washington, D. C.
Chemical materials and supplies.	Ohio State University, Columbus, Ohio.
Caustic soda.	The Isaac Winkler & Bros. Co., Buffalo, N. Y.
Caustic soda.	Diamond Alkali Co., Pittsburgh, Pa.
Caustic soda.	Mathieson Alkali Works, Providence, R. I.
Ammonia compressors.	Triumph Ice Machine Co., Cincinnati, Ohio.
Condensers.	Triumph Ice Machine Co., Cincinnati, Ohio.
Soda ash.	Isaac Winkler & Bros., Cincinnati, Ohio.
Picric acid.	Semet-Solvay Co., Syracuse, N. Y.
Oxygen cylinders.	Tindel-Morris, Eddystone, Pa.
Saltpeter.	Hercules Powder Co., Wilmington, Del.
Caustic soda.	Wing & Evans (Inc.), New York City, N. Y.

MR. C. H. VOM BAUR has been elected vice-president of the T. W. Price Engineering Company. He has designed, operated and installed over thirty electric furnaces in this country, and is joint author of the book on "Electric Furnaces in the Iron and Steel Industry." This company has designed and installed new plants for the Ludlum Steel Co., Watervliet, N. Y.; Hammod Steeel Co., Syracuse, N. Y.; Century Steel Co., Poughkeepsie, N. Y.; Ulster Iron Works, Dover, N. J.; Hubbard Steel Foundry Co., East Chicago, Ind., and numerous others. The offices of the company are in the Woolworth Building, New York City, and 14 East Jackson Boulevard, Chicago, Illinois.

THE RAINEY-WOOD COKE CO. has been organized by the W. J. Rainey interests, operating coal mines and coke works in the Connellsville region, and the Alan Wood, Iron & Steel Co., with blast furnaces and steel works at Swedeland, Pa., for the purpose of constructing a large by-product coke plant of 330 ovens at Swedeland, Pa. The coal for this plant will be furnished by W. J. Rainey from their mines in the Connellsville region. Work has been started on the first unit of 110 of these ovens, and it is expected to have the plant in operation within fourteen months. This first installation will supply coke, gas and tar to the Alan Wood, Iron & Steel Co. and will have sufficient additional capacity to furnish foundry coke for the Eastern market. A complete by-product recovery plant will also be constructed for the purpose of furnishing sulphate of ammonia and toluol to the U. S. Government. It is proposed to install the remaining units at the earliest possible date, in order to insure a continued coke supply for the independent blast furnaces in the Schuylkill and Lehigh Valleys.

THE INDEPENDENT FILTER PRESS CO., INC., has removed from 47 West 34th Street, New York, to 418 Third Avenue, Brooklyn, N. Y. The factories and office are now under one roof and the manufacturing is to be done under the supervision of Mr. A. Cuttrell. Double the amount of machinery has been added in order to give prompt and quick deliveries.

New Publications

NEW BUREAU OF MINES PUBLICATIONS: Bulletin 110, Concentration Experiments on the Siliceous Red Hematites of the Birmingham District, Ala. By J. T. Singewald, Jr.; Bulletin 132, Siliceous Dust in Relation to Pulmonary Disease Among Miners in the Joplin District, Mo. By Edwin Higgins, A. K. Lanza, F. B. Laney and G. S. Rice; Bulletin 146, Technology of Salt Making in the United States. By W. C. Phalen; Technical Paper 148, The Determination of Moisture in Coke. By A. C. Fieldner and W. A. Selvig; Technical Paper 182, Flotation of Chalcopyrite-Pyrrhotite Ores of Southern Oregon. By Will H. Coghill; Technical Paper 183, New Views of the Combustion of the Volatile Matter in Coal. By S. H. Katz; Technical Paper 201, Accidents at Metallurgical Works in the United States During the Calendar Year 1916. By Albert H. Fay; Bulletin 151, Recovery of Gasoline from Natural Gas by Compression and Refrigeration. By W. P. Dykema; Technical Paper 185, Use of the Interferometer in Gas Analysis. By Frank M. Seibert and Walter C. Harpster; Technical Paper 202, Metal-Mine Accidents in the United States during the Calendar year 1916. Compiled by Albert H. Fay; and Bulletin 149, Bibliography of Petroleum and Allied Substances, 1915. By E. H. Burroughs.

NEW BUREAU OF STANDARDS PUBLICATIONS: No. 321, Thermal Expansion of Alpha and the Beta Brass Between 0 and 600 deg. C., in Relation to the Mechanical Properties of Heterogeneous Brasses of the Muntz Metal Type. By P. D. Merica and L. W. Schad, issued May 9, 1918; No. 104, Effect of the Size of Grog in Fire-Clay Bodies. By F. A. Kirkpatrick, issued March 12, 1918.

CIRCULAR LETTER VIII-4, giving a working bibliography of reference, and handbooks on the properties of metals and alloys. This circular has been prepared in answer to numerous requests for general and comprehensive information and can only be answered with a statement of the sources where such information can be obtained.

TANNING MATERIALS OF LATIN AMERICA. By Thomas H. Norton. Copies of the report can be obtained at the nominal price of 5 cents by addressing the Superintendent of Documents, Washington, D. C., or to any of the District Offices of the Bureau of Foreign and Domestic Commerce.

AN INDUSTRIAL SURVEY OF SEATTLE. By Curtis C. Aller. Bulletin No. 3, issued by the University of Washington, Bureau of Industrial Research, Seattle, Wash.

FUEL ECONOMY IN THE OPERATION OF HAND-FIRED POWER PLANTS. Circular No. 7, published by the University of Illinois, Urbana, Ill. Price $0.20.

MINING ENGINEERING AS A PROFESSION. A publication of the University of Arizona, College of Mines and Engineering, Tucson, Arizona.

THE HARRISON WORKS, paint and chemical manufacturers owned and controlled by E. I. du Pont de Nemours & Company of Wilmington, Delaware, have just issued six booklets as follows: "Harrison Blue Ribbon Chemicals"; "Town and Country Paint"; "Harrison Oil Stains"; Harrison Automobile and Carriage Paint"; "Harrison Porch Chair Enamel" and "Shingle Homes." Copies may be had upon request.

EMERGENCY WAR TRAINING FOR AIRPLANE MECHANICS. Bulletin No. 12, issued April, 1918, by the Federal Board of Vocational Education, Washington, D. C.

"MANUFACTURING OPPORTUNITIES IN THE STATE OF WASHINGTON" has just been issued by the State Bureau of Statistics and Immigration, State of Washington, Olympia. Copies may be had upon application.

THE UNIVERSITY OF IDAHO, Moscow, Idaho: Vol. XIII, No. 1, which is the annual catalog for 1917-1918 issued May, 1918, with announcements for 1918-1919.

Manufacturers' Catalogs

P. H. & F. M. ROOTS COMPANY, Connersville, Ind.: Catalog 63 illustrating and describing rotary gas exhausters for foul gas pumping service, corrosive gas handling with high-pressure booster service and special linings.

J. P. DEVINE COMPANY, Buffalo, N. Y.: Bulletin No. 105A which describes and illustrates apparatus for the color, chemical, dyestuff and allied industries. Copies of this bulletin can be had by applying to the above company.

BUFFALO FORGE COMPANY, Buffalo, N. Y.: Section No. 108, March, 1918, covering stationary forges.

COMPUTER MFG. CO., 25 California St., San Francisco, Calif.: A booklet on the Ross precision computer which is said to be equivalent to a slide-rule 100 feet long.

THE BRAUN CORPORATION, Los Angeles, Calif.: Catalog No. 50 on the Braun laboratory appliances, describing and illustrating the many different types.

THE BROWN INSTRUMENT COMPANY, Philadelphia, Pa., has just issued an interesting chart printed in four colors showing the melting points of chemical elements, together with a heat-color scale giving a useful conversion table of Fahrenheit and Centigrade degrees. The color-scale includes 50 elements from nitrogen to carbon, and should be found valuable in all kinds of heat treating work.

THE COLORADO FUEL & IRON COMPANY, Denver, Colorado: Industrial Bulletin, Vol. III, No. 3, April 30, 1918, which contains articles of timely interest for the information of their employees.